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UTILIZATION OF BUTTERMILK IN THE FORM OF CONDENSED AND DRIED BUTTERMILK[1]

O. F. HUNZIKER

Blue Valley Creamery Company, Chicago, Illinois

Received for publication October 23, 1922

ANNUAL VOLUME OF BUTTERMILK PRODUCED IN UNITED STATES

According to figures compiled by the United States Department of Agriculture the total output of American Creamery butter in 1921 was 1,054,938,329 pounds.

Assuming that with each pound of butter manufactured there is produced 1.5 pounds of buttermilk, the total production of factory buttermilk would amount to about 1,562,407,494 pounds.

USES OF BUTTERMILK

Aside from its use for feeding purposes, buttermilk has been found valuable and useful as the basis for diverse manufacturing purposes. It is used in bakeries and in the manufacture of prepared foods, for cottage cheese and milk beverages, casein products, lactic acid and similar industrial products.

The volume of buttermilk used for these miscellaneous purposes, however, represents but a very small portion of the total annual supply of buttermilk, and it is fair to admit that at this stage of the industry those sundry purposes are as yet a negligible factor in the solution of the economic utilization of the buttermilk supply.

The basic value of buttermilk lies in the high quality of its solid ingredients for feeding purposes, and it is through the channel of feeding the buttermilk to farm animals and fowl, and to a limited extent to the human family, that the more

[1] Delivered before the Manufactures Section of the American Dairy Science Association, October 10, 1922, St. Paul, Minnesota.

complete and economic utilization of the vast bulk of our annual output of buttermilk must find its ultimate solution.

On the basis of 30 cents per hundred pounds, which is a very conservative estimate when compared with present prices of grain (corn now ranges between 60 and 65 cents per bushel) the value of the annual output of 1,582,000,000 pounds of buttermilk represents a value to the farmer of the country of approximately $4,750,000.

If disposed of by the butter manufacturer at the conservative price of 1 cent per gallon or 12 cents per 100 pounds, it would net the creameries of the country annually around two million dollars.

A considerable volume of buttermilk is returned direct to the farmer for hog and poultry feeding. This direct outlet is confined largely to local creameries where the cow population is dense and the distance from farm to factory is relatively short. And even in this case, the demand for the buttermilk is very irregular and the facilities for its proper disposition through this channel are entirely inadequate to the supply.

In the larger creameries, that receive their cream supply from a much wider radius, the distance of the average patron from the creamery limits the amount of buttermilk that can be returned direct to the farmer to a very small volume. This is especially true in the case of the creameries located in large cities.

Prior to the World War the great bulk of the buttermilk supply was a complete loss. It was run into the sewer, although some efforts had been made for several years to convert the buttermilk into a more concentrated form and into a form that would render it less perishable and that enhanced its keeping quality.

DEVELOPMENT OF MANUFACTURE OF CONDENSED AND DRIED BUTTERMILK

The manufacture of condensed buttermilk and of dried buttermilk prior to the World War was exceedingly limited. In fact, it did not really go beyond the experimental state, only a very

limited amount of either product reaching the market. The relatively low price of grain feeds and of pork, poultry and eggs did not seem to justify the addition to the price of fluid buttermilk of the comparatively high cost of manufacture into the more concentrated products. Also the process of condensing and drying buttermilk had not as yet reached the point where products of dependable keeping quality were entirely assured.

Practically the only kind of so-called condensed buttermilk then made at all, was not really the result of concentration proper. It was a product made by heating the buttermilk in large tanks to the boiling temperature long enough for the curd to contract and to settle to the botton, leaving a practically clear whey on top. This whey was drawn off and thrown away. The residue, consisting of the curdy material and as much of the whey as adhered to or remained mixed with it constituted the condensed buttermilk. It is obvious that this product was not a complete buttermilk, much of the lactose, lactic acid and mineral salts having been lost. Only a small quantity of this product ever reached the market.

Small quantities of dried buttermilk were also made and used largely in mixed feeds for poultry.

The feed shortage and the high prices of all farm products caused by the ravages of the World War greatly emphasized the possibilities and the value of preserving such by-products as buttermilk. With prices of farm products doubling and in some instances trebling, and the demand for these products reaching far beyond their supply, the cost of concentrating and of drying buttermilk was no longer a serious obstacle. The farmer and the feeder could afford to pay the price and the manufacture of these concentrated products became a profitable industry.

The processes of manufacture were perfected rapidly and the volume of these finished products, condensed buttermilk and dried buttermilk, increased by leaps and bounds.

Like in other similar industries the attractiveness of the possible profits during the years of forced prosperity created by the war, so in the manufacture of condensed and dried butter-

milk it led to overproduction, I mean production greater than the demand, in normal times. With the general business depression and reaction that set in a few years ago, and the resulting decrease in the demand and depreciation of the value of farm products, these industries too suffered and will continue to suffer to some extent until the period of reconstruction will have reached a point of reasonable stability and comparative normalcy.

However, the efforts put into these industries have by no means been in vain. They have developed definite processes of manufacture of condensed buttermilk and of dried buttermilk. These products have been tried out and found useful and their value as stock feeds has been definitely established and is recognized.

Reports from those close to the industry point to the fact that the volume of production for 1922 is far in advance of 1921 and that there is a rapidly increasing demand on the part of the feeder for these products. Much educational work has been done during the last two years in acquainting the feeder with the value and proper use of these products. This has helped and will continue to assist in accelerating their use and their demand.

The total output of condensed buttermilk in 1921 was 29,313,767 pounds. This represents approximately 87,941,301 pounds of fluid buttermilk or 5.6 per cent of the total annual amount of fluid buttermilk produced. The total output of dried buttermilk for the same year was 7,708,384 pounds. This represents approximately 77,084,000 pounds of fluid buttermilk or 4.9 per cent of the total annual output of the fluid buttermilk. With other words, about 10.5 per cent of the 1,582,407,494 pounds of fluid buttermilk produced in 1921 was utilized for the manufacture of condensed buttermilk and dried buttermilk.

Practically the entire make of 29,313,767 pounds of condensed buttermilk was sold for feeding purposes. Only negligible amounts went to bakeries. Of the total of 7,708,384 pounds of dried buttermilk approximately 200,000 pounds went for human consumption. The remainder was used for feeding purposes.

The great bulk of condensed buttermilk is manufactured by evaporation in the vacuum pan similar as in the case of the manufacture of condensed milk. The process of concentrating

buttermilk in vacuo is covered by patent of the Grelck-Hovey Patent Company of St. Paul, Minn.

In the manufacture of dried buttermilk, both the spray process and the roller process have been employed. In the spray process as used in the central west, the buttermilk is first condensed in the vacuum pan and the condensed buttermilk is then atomized and dried in a current of hot air. This process is covered by the Merrill-Soule Company patent. The amount of buttermilk powder so manufactured is very small.

Practically 90 per cent of the entire output of dried buttermilk for the year 1921 was made by the roller process covered by patent of the Collis Products Company of Clinton, Iowa. In this process the buttermilk is kept in a thoroughly agitated condition and is sprayed on a steam heated revolving roller which makes about two revolutions per minute and the temperature of the product reaches about 190 to 200°F. The thin film of drying buttermilk that forms on the roller is automatically removed by a stationary sharp knife. This thin film is still slightly moist when it comes off the roller, but it surrenders the remainder of its removable moisture quickly to the atmosphere. Instead of spraying the uncondensed fluid buttermilk on the roll, the buttermilk may be precondensed and then sprayed on the roll.

Some dried buttermilk is also manufactured by the roller process of the Just-Hatmaker type of machine (two rollers) and by the roller process in vacuum, which was originally invented by Dr. Ekenberg of Stockholm, Sweden, and the machinery of which is now manufactured and patented by the Buffalo Foundry and Machine Company, Buffalo, N. Y.

COMPOSITION

Neither condensed nor dried buttermilk contain any ingredients not present in the original buttermilk, nor is any ingredient present in the original buttermilk decreased or removed except the water. The two products differ from each other only in their degree of concentration. The proportion of the individual

solid ingredients to one another in each product is practically the same and it is the same also as it is in the fluid buttermilk with the exception of the percentage of lactic acid which is relatively much higher and the percentage of milk sugar which is correspondingly lower in the condensed buttermilk than in the dried buttermilk and than in average fluid buttermilk.

The ratio of concentration of condensed buttermilk averages about three to one, but there is a very considerable variation in different lots of condensed buttermilk that reach the market. Since fluid buttermilk averages about 9 per cent total solids and 91 per cent water, the condensed buttermilk averages from about 25 to 33 per cent total solids and from about 67 to 75 per cent water.

In dried buttermilk the ratio of concentration is slightly over 10 to 1. It is more even in its composition. It contains from about 90 to 95 per cent milk solids and from about 5 to 10 per cent water.

KEEPING QUALITY

Condensed buttermilk is a far more perishable product than dried buttermilk. In order to lend it proper keeping quality, the buttermilk before condensing must be soured to a point sufficient to produce a condensed buttermilk with not less than 3 to 3.5 per cent acid, calculated as lactic acid. If the acid content of the condensed buttermilk drops below the above figure, the product deteriorates very rapidly, usually becoming moldy and putrid. Also the contents of remnant barrels of condensed buttermilk mold very profusely unless the surface of the condensed buttermilk is protected from the air, as can be readily done by covering it with heavy paper, or similar material.

Dried buttermilk has very good keeping quality. Its high acid content, which is around 5 per cent, due to its high ratio of concentration, and its relatively low moisture content, act as effective preservatives. It keeps best, however, when protected against air and heat.

FOOD VALUE AND MARKET PRICE

From the standpoint of the percentage ingredients as determined by chemical analysis, the relative food value of condensed buttermilk and of dried buttermilk is controlled entirely by the ratio of concentration or the percentage of total solids. On this basis, the dried buttermilk has at least three times the food value of condensed buttermilk and condensed buttermilk has about three times the food value of fluid buttermilk. The market price of condensed buttermilk for feeding purposes is about 5 cents per pound. The market price of dried buttermilk for feeding purposes is about 8 cents per pound. Feeders who buy these concentrated products direct from the manufacturer may secure them at a reduction of from ½ to 1½ cents or slightly over. The above prices are jobbers' prices to the feeder.

Based on the percentage of total solids in the two products, therefore, it would appear that the feeder of dried buttermilk receives considerably more milk solids and therefore greater food value for every dollar expended than the feeder of condensed buttermilk. Also there is much less danger of loss by spoiling, there is less storage room required and the cost of transportation is less than in the case of condensed buttermilk. Comparing dried buttermilk with an average per cent of solids of 92½ per cent and a cost to the feeder of 8 cents per pound, and condensed buttermilk with an average per cent of solids of 27 per cent and a cost of 4 cents per pound with the value of fluid buttermilk testing 9 per cent solids, the feeder when buying dried buttermilk is paying at the rate of 78 cents per hundred pounds or 6.3 cents per gallon of fluid buttermilk. In case of condensed buttermilk he is paying at the rate of $1.33 per hundred pounds, or of 11 cents per gallon of fluid buttermilk.

When sold direct by manufacturer to the feeder the price to the feeder is considerably less. Dried buttermilk sells at 6½ cents and condensed buttermilk sells at 3½ cents per pound. At these prices the feeder, when buying dried buttermilk, would be paying at the rate of 65⅔ cents per hundred or 5½ cents per gallon of fluid buttermilk. When buying condensed buttermilk he would

be paying at the rate of $1.16 per hundred or 9½ cents per gallon of fluid buttermilk.

It is further claimed that in the case of condensed buttermilk, the real value of the product as a feed is materially augmented by its very high content of acid, calculated as lactic acid. Condensed buttermilk contains about 3.5 per cent acid.

That lactic acid in the diet has a value as a tonic is generally admitted by nutrition and health experts. Its value lies in cleansing the intestines from putrefaction and keeping them in a healthy condition; in accelerating the power of assimilation of other feeds in the ration, thereby augmenting their digestibility and their economy as feeds; and in giving the animal greater capacity for the consumption of feed and water.

To what extent this tonic effect of condensed buttermilk does increase the value of this product, is as yet undetermined. It is reasonable to assume that the effect is advantageous but the information available is as yet too limited to interpret this value in terms of dollars and cents.

VITAMINE PROPERTIES

There are no experimental data on record, or at least I have been unable to find any, on the relative vitamine properties of condensed and dried buttermilk, nor even of liquid buttermilk. However, the effect of condensing and dehydrating of milk has been subjected to considerable study and it may be justifiable to use these data as an approximate criterion of the vitamine properties in the buttermilk products.

Ellis and Macleod (1), Sherman and Smith (2), Funk (3), and Eddy (4), in their respective reviews of experimental results with condensed milk and dried milk when fed to rats, other animals and to children, point out that neither the fat soluble A nor the water soluble B vitamines were noticeably affected by the processes of evaporation and drying.

Vitamine C, the antiscorbutic vitamine, on the other hand, suffered variably according to the process used. Condensing in vacuo and drying by the roller process had the least unfavorable effect. The spray drying process at high temperatures in the

drying chamber and exposure of the milk powder for several hours on the floor of the drying chamber practically destroyed vitamine C.

These data suggest quite clearly that neither the condensing of buttermilk in the vacuum pan, nor the drying of the buttermilk by the roller process, both processes whereby the great bulk of condensed buttermilk and dried buttermilk respectively, are manufactured, have any appreciable effect on the vitamine properties of the finished product.

The fact that the fat soluble A and the water soluble B vitamines are preserved during the processes of heating, condensing and dehydrating is important because the grain feeds are deficient in these vitamines and the buttermilk products thus are a valuable supplement to these feeds. The possible depreciation or destruction of vitamine C in the buttermilk products is of negligible importance as the grain feeds amply supply this vitamine.

However, it should be understood that the results above referred were obtained with milk products and not with buttermilk products. It is possible, though not probable, that the same processes that are harmless or negative as far as their effect on the vitamine properties of sweet milk is concerned, may have a different influence in the case of highly acid buttermilk.

DIGESTIBILITY

Accurate data on the relative digestibility of dried and condensed buttermilk as compared with fluid buttermilk are likewise lacking. Dr. Miner (5) of the Miner Laboratories, Chicago, reports a limited number of digestibility tests made in the laboratory. These tests indicated that the digestibility of the condensed and dried buttermilk was equal to that of the fluid buttermilk. These results correspond with those of digestibility tests with condensed and dried milk reported by numerous investigators. However, the digestibility tests on the condensed and dried buttermilk were restricted to laboratory tests only and limited in number. They therefore should be accepted as an indication rather than as a proven fact.

FEEDING EXPERIMENTS

Results of carefully executed feeding experiments that show the comparative food value and economy are as yet too limited to arrive at definite conclusions and in many cases the experiments were made with products especially furnished for the purpose by the manufacturer. While experiments conducted under such circumstances are of unquestionable value, the results obtained therefrom, should be amply verified by experiments on a broader scale with products as they appear in the trade, before they can be accepted as scientifically established and unbiased facts.

Evvard and Dunn (6) of the Iowa Experiment Station report experimental results with dried buttermilk for pigs. Dried buttermilk was added to the basal ration of corn, tankage and salt. The dried buttermilk increased the gains on pigs and decreased the feed requirements for a 100-pound gain. The buttermilk proteins proved more efficient than the tankage proteins, but the buttermilk proteins cost more than the tankage proteins. From the standpoint of economy, tankage at $100 per ton for market pig feeding proved much more efficient than buttermilk powder at $200 per ton, the relative prices at the time of the experiment. On the basis of the above prices and the relative feeding results these investigators place the value of buttermilk powder at $4 per hundred weight.

Mr. H. I. Macomber (7) of the Poultry Division of the United States Department of Agriculture reported experiments with laying hens. Fifteen per cent of dried buttermilk was fed in a poultry mash as compared with 25 per cent meat scrap of a 55 per cent protein analysis. The hens were laying as well on the buttermilk as on the meat scrap. Condensed buttermilk was also used, for its tonic value, but not to replace all of the animal protein feed. While the experiment is not as yet completed and it is too early for accurate figures as to cost, indications are that 15 per cent dried buttermilk in the mash will cost as much as 25 per cent of the meat scrap with present prices. Their observations are that the dried buttermilk is a much easier form of feed to handle than the condensed buttermilk and that the dried

buttermilk apparently was as satisfactory as a feed. Macomber further reports that both of these feeds have also been used in poultry fattening tests with the same comparative results as noted in the feeding of laying hens. He concludes that in his opinion more experimenting is required to arrive definitely at conclusions regarding the relative merits of dried and condensed buttermilk.

Philips (8) in Purdue Bulletin 258 reports results of feeding experiments with fluid and dried buttermilk with laying hens. Pullets in the dried buttermilk pen laid on an average of 189.4 eggs, in the fluid buttermilk pen 164.7 eggs, in the no buttermilk pen 56.6 eggs. It cost 16 cents for feed to produce one dozen eggs in both the dried and the fluid buttermilk pens, and 33 cents in the no buttermilk pen.

The profit over feed from the dried buttermilk pen was $5.69, from the fluid buttermilk it was $4.92, and from the no milk pen it was $0.78. The feeding value of dried buttermilk was $55.10 per 100 pounds, and of the fluid buttermilk it was $5 per 100 pounds.

The dried buttermilk produced the best fertility of eggs and the fluid buttermilk the poorest. The mortality in the dried buttermilk pen and the fluid buttermilk pen was the same. That in the no milk pen was much heavier.

Similar results are also reported in experiments with chickens conducted at the Iowa Experiment Station, but the experiments are not as yet entirely complete.

SUMMARY

The utilization of the great bulk of the vast volume of creamery buttermilk annually produced in the form of condensed buttermilk and dried buttermilk gives promise to be of distinct economic value both to the feeder of farm animals and as a means to minimize waste of a valuable marketable by-product to the creamery.

While considerable quantities of these concentrated by-products are now being manufactured and marketed to the advantage of feeder and manufacturer, this industry is as yet in its infancy.

This, together with the fact that supplies such as coal and package, also labor and transportation, are as yet abnormally high, has been a handicap that has worked against the full realization of the possibilities of maximum efficiency and of minimum cost of manufacture.

Knowledge of the comparative feeding value of these two products is as yet limited but much and extensive experimental work is in progress, the result of which promises to reveal facts of great economic value to feeder and manufacturer. Information now available indicates that the food value, digestibility and vitamine properties originally contained in the fluid buttermilk are not materially affected by the processes of condensation and drying now used in the manufacture of these products.

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(8) Philips: Purdue Bullentin No. 258.

CLASS LEADERS IN AGRICULTURAL COLLEGE HERDS

H. P. DAVIS AND R. A. BRAUN

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Received for publication November 1, 1922

Probably every agricultural college in the United States has a herd of dairy cattle. It would not seem to be possible to successfully carry on the dairy work at the institution without some dairy animals. Since there are four principal breeds of dairy cattle that have any general distribution throughout the country, the ideal condition would be to have each represented at the several institutions. A herd of dairy cattle at the state agricultural college serves a number of purposes: (1) Furnishes animals for instructional work in dairy cattle judging; (2) Furnishes animals for experimental work; (3) Furnishes milk for use in instructional work; (4) Furnishes milk for experimental work; (5) Serves as an ideal toward which the breeders of the state may strive. Very likely many college herds do not, to the fullest extent, serve all the functions mentioned. Especially is the last mentioned difficult to perform. Many, if not most, of the colleges have been greatly hampered from lack of funds for the purchase of foundation females or the proper kind of sires to successfully carry on breeding operations. At various times during the last few years, it has been the privilege of the senior author to visit many of the agricultural colleges and the records then prevailing and those presented here show a remarkable improvement in the productive ability of their dairy cows. It is considered doubtful if the breeders of dairy cattle generally, appreciate how good the college herds are at present and it was also thought likely that those connected with the various institutions would like to know how their herds compared with those of other places. With this in mind a questionnaire was sent out to thirty-five institutions asking for the leading official record cow in each of the age classes for the four breeds, Holstein, Jersey, Guernsey

and Ayrshire. Replies containing information were received from twenty four institutions. Only cows actually in the herd were to be included and only those having official records. The average production figures were not received from enough institutions to warrant their presentation. In general the records given represent March 1, 1922. Unquestionably, a number of excellent records have been made since that date which would change the leaders.

HOLSTEINS

Of the twenty-four institutions replying, twenty-three reported owning Holsteins, the University of Maryland alone owning none. The highest butterfat record reported for the aged cow class (cows five years old or over) was made by La Verna Lincoln owned by the University of Nebraska whose record is 29,555.5 pounds of milk and 1048.4 pounds of butterfat. She is also the highest producing cow in butterfat owned by any of the agricultural colleges, and it is believed that she is the highest milk producer. In this class three institutions report cows producing over 900 pounds of butterfat; six report cows producing over 800 pounds of butterfat; ten report cows producing over 700 pounds of butterfat; fifteen report cows producing more than 600 pounds of butterfat and nineteen report cows producing more than 500 pounds of butterfat. The average production for the twenty-two cows reported in the mature Holstein class is 20,382.5 pounds of milk and 695.7 pounds of butterfat. It must be remembered that the questionnaire asked only for the highest producing cow in a particular class. Undoubtedly, many institutions own several cows that are above the leading animals from other institutions.

The senior four year olds are led by Juna Longfield Homestead owned by the University of Illinois with a production record of 24,655.5 pounds of milk and 828.5 pounds butterfat. In this class there are two cows with records of over 700 pounds of butterfat, six cows over 600 pounds butterfat and 14 cows having produced more than 500 pounds butterfat. The average production for the nineteen cows in this class is 17,221.2 pounds of milk and 568.5 pounds butterfat.

The junior four year old class is led by Virginia Polytechnic Institute with the cow V. P. I. Veeman De Kol whose production is 17,333.0 pounds of milk and 764.0 pounds butterfat. This class has two cows above 700 pounds of fat, six cows above 600 pounds of fat and fifteen cows having produced more than 500 pounds of butterfat. The average production for the nineteen cows in this class is 16,244.5 pounds milk and 557.7 pounds of butterfat.

California Agnes Colanthaa owned by the University of California leads the senior three year old class with a production of 19,409.6 pounds of milk and 689.9 pounds of butterfat. This class has four cows producing more than 600 pounds of butterfat and eight cows producing more than 500 pounds of butterfat. The average milk production for the eighteen cows reported in this class is 15,271.8 pounds milk with 514.0 pounds of butterfat.

Illini Dulcina De Kol owned by the University of Illinois tops the junior three year old class with a production of 17,755.4 pounds of milk and 719.7 pounds of butterfat. In this class there are six cows above 600 pounds of fat and eleven cows above 500 pounds of fat. The seventeen cows reported in this class have an average production of 15,426.2 pounds milk and 529.9 pounds of butterfat.

California Pietertje Bloom Mead owned by the University of California leads the senior two year old class with a production of 19,985 pounds of milk and 722.2 pounds of butterfat. Two cows in this class produced more than 700 pounds of butterfat, three cows more than 600 pounds of butterfat and nine cows more than 500 pounds butterfat. The nineteen cows in this class have an average of 15,172.7 pounds of milk and 514.17 pounds of butterfat.

Junior two year olds are led by Fairy Aaggie Korndyke Colantha owned by the University of Minnesota whose production is 20,005.5 pounds of milk and 696.8 pounds butterfat. Two cows in this class have records of more than 600 pounds of fat and five cows have records of more than 500 pounds of fat. The average for the twenty-two cows in this class is 13,111.8 pounds of milk and 447.21 pounds of butterfat. The average of all the 136 Holstein cows is 16,162.8 pounds of milk and 547.73 pounds of butterfat.

JERSEYS

As in Holsteins twenty-three institutions reported Jerseys. Among the Jerseys, Majesty's Iris owned by the University of Illinois leads the mature cow class and all Jersey classes with a production of 17,469.7 pounds of milk and 955.8 pounds butterfat. Two Jerseys in the mature class have produced more than 900 pounds of butterfat; three have produced more than 800 pounds of fat; five have produced more than 700 pounds of fat; fourteen have produced more than 600 pounds of fat and sixteen have produced more than 500 pounds of butterfat. The eighteen cows in this class have an average production of 12,259.8 pounds of milk and 673.3 pounds butterfat.

Senior four year old Jerseys are led by Lass Princess owned by the Massachusettss Agricultural College who produced 10,808.0 pounds of milk and 701.1 pounds butterfat. This class has seven cows that have produced more than 600 pounds of butterfat and eleven cows that have produced more than 500 pounds of butterfat. The fifteen members of this class have an average production of 9,999.1 pounds milk and 542.2 pounds of butterfat.

Interested Jap's Santa owned by the University of California leads the junior four year olds with a production of 13,308.5 pounds of milk and 805.72 pounds of butterfat. Three cows in this class have produced more than 600 pounds of butterfat and seven cows have produced over 500 pounds of butterfat. The eleven cows reported in this class have an average production of 9,950.0 pounds of milk and 535.77 pounds fat.

Oregon Maple G owned by the Oregon Agricultural College leads the senior three year olds, having produced 10,776.0 pounds milk and 650.2 pounds butterfat. Three cows in this group have produced more than 600 pounds of butterfat and ten cows have produced more than 500 pounds of butterfat. Fifteen cows were reported in this class and the average production is 9,472.3 pounds of milk and 521.66 pounds butterfat.

Trill Pogis of Lily Dale owned by the University of Minnesota leads the junior three year old class with a production of 12,159.0 pounts of milk and 682.0 pounds butterfat. Two cows in this group have produced more than 600 pounds of butterfat and two

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cows have produced more than 500 pounds of butterfat. The average production of the sixteen cows in this class is 8,413.2 pounds of milk and 444.5 pounds of butterfat.

Interested Jap's Santa owned by the University of California is again the leading cow in the senior two year old class with a production of 9,051.0 pounds of milk and 588.2 pounds butterfat. Three cows in this group have produced more than 500 pounds butterfat. The average production of the fifteen cows reported in this class is 7,736.8 pounds of milk and 413.2 pounds butterfat.

Pennsylvania State College leads the junior two year olds with Penstate's Torono's Blacky who produced 9,854.7 pounds milk and 532.3 pounds butterfat. Two cows in this class have records of more than 500 pounds butterfat. The nineteen cows in this class have an average production of 7,865.5 pounds milk and 419.6 pounds butterfat. Altogether the 109 Jerseys averaged 9,378.8 pounds milk and 520.3 pounds butterfat.

GUERNSEYS

Twenty institutions reported Guernseys, but there were more classes unfilled which seems to indicate that the Guernsey herds are smaller. Yeksarose 4th, owned by the University of Illinois leads the Guernseys in the mature class and in all classes in butterfat production, her record being 14,527.1 pounds milk and 753.7 pounds fat. Seven cows in this group have a production of over 600 pounds butterfat and ten cows have more than 500 pounds butterfat. The twelve cows in this class have an average production of 12,749.9 pounds milk and 619.7 pounds butterfat.

College King's Nantaska owned by the Massachusetts Agricultural College leads the senior four year old class with 14,811 pounds milk and 684 pounds of butterfat. Two cows in this group have produced more than 600 pounds butterfat and an equal number have produced more than 500 pounds butterfat. Only nine cows were reported in this class and they have an average production of 9,581.5 pounds milk and 453.2 pounds butterfat.

Delza 3rd, owned by Pennsylvania State College takes front rank in junior four year olds with a production of 10,608.7 pounds

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milk and 542.5 pounds fat. Two cows produced over 500 pounds fat and the average of the 8 cows was 9,045.5 pounds milk and 443 pounds fat.

Nantaska Beauty owned by the Massachusetts Agricultural College with a production of 11,359 pounds of milk and 608 pounds of butterfat ranks first among the senior three year olds. Two cows in this group have records of more than 600 pounds butterfat and four cows have records of more than 500 pounds butterfat. The average production of the eight cows in this class is 9,803.3 pounds of milk and 489.2 pounds butterfat.

Squire des Blicqs's Ramona of Beatrice owned by the University of Nebraska leads the junior three year old class having produced 10,672 pounds of milk and 501 pounds of butterfat. The average production of the nine cows reported in this class is 8,223.1 pounds milk and 416 pounds butterfat.

Imp. Rouge II of the Brickfield owned by the Iowa State College is the leading cow among the senior two year olds. Her production being 10,963 pounds milk and 612.5 pounds butterfat. Two cows in this class have produced more than 500 pounds of butterfat. The average for the ten members in this class is 8,219.1 pounds milk and 418.9 pounds butterfat.

May King's Alvada owned by Clemson Agricultural College (S.C.) leads the junior two year olds with a production of 12,294.9 pounds milk and 538 pounds butterfat. Four cows in this group have produced more than 500 pounds butterfat. The fifteen cows in this class have an average production of 8,200.3 pounds milk and 417.1 pounds butterfat. Considering all classes seventy-one Guernseys averaged 9,425.7 pounds of milk and 467.1 pounds of butterfat.

AYRSHIRES

Eighteen institutions reported Ayrshires and in this breed also the indications point to small herds. Canary Bell owned by the Kansas State Agricultural College leads the mature Ayrshires and all Ayrshires in both milk and butterfat production. Her record being 19,863 pounds milk and 744.51 pounds of butterfat. Two Ayrshires in this class have produced more than 700 pounds

of butterfat; four more than 600 pounds butterfat and eight have produced more than 500 pounds of butterfat. The average of the fourteen entries in this class is 12,631.1 pounds milk and 537.5 pounds butterfat.

Bangora's Fizzaway owned by Purdue University, Indiana, leads the senior four year olds with a production of 14,983 pounds milk and 532 pounds butterfat. Three cows in this group have produced more than 500 pounds butterfat. Only seven entries were reported in this class with an average production of 12,389.5 pounds of milk and 478.6 pounds butterfat.

Victor's Beauty Lass, a junior four year old owned by the Massachusetts Agricultural College leads her class with a production of 15,980 pounds of milk and 666 pounds butterfat. Two cows in this class have produced more than 500 pounds butterfat. The ten members of this class have an average production of 11,220.3 pounds milk and 450.4 pounds butterfat.

Bangora's Melrose owned by the Kansas State Agricultural College is the leader of the senior three's with a production of 14,515 pounds milk and 568.1 pounds butterfat. Two cows in this group have produced more than 500 pounds butterfat. Only six entries are reported in this class with an average production of 10,997.8 pounds milk and 474.4 pounds butterfat.

Cavaliers Robin Hood Lass of the Iowa State College is leading the junior three year old class, her production being 9,830 pounds of milk and 472.4 pounds butterfat.

Juno of Rossbourg owned by the University of Maryland leads the senior two year old's with a production of 12,371 pounds of milk and 537 pounds of butterfat. Three cows in this group have produced more than 500 pounds of butterfat. The average production of the nine cows reported in this group is 10,346.3 pounds of milk and 434.7 pounds butterfat.

Melrose Canary Bell owned by the Kansas State Agricultural College leads the junior two year old class with a production of 13,785 pounds of milk and 502.9 pounds of butterfat. She is the only cow in this class which has a production of more than 500 pounds butterfat. The average production for the eleven entries in this class is 9,086.1 pounds milk and 378.6 pounds butterfat.

In Ayrshires sixty-eight cows in all classes averaged 10,787.4 pounds milk, 446.8 pounds of butterfat.

Holsteins

RANK	OWNER	COW	MILK	FAT
		Mature Holsteins		
			pounds	*pounds*
1	University of Nebraska	La Verna Lincoln	29,555.5	1,048.4
2	Virginia Polytechnic Institute	Buckeye De Kol Pauline 2nd	20,784.0	927.0
3	University of Illinois	Illini Homestead Beachwood	25,535.1	901.6
4	Connecticut Agricultural College	De Kol Hubbard Pietertje	23,175.7	830.7
5	University of Idaho	Idaho Violet Posch Ormsby	21,379.3	805.9
6	Kansas State Agricultural College	Carlotta Empress Fobes	27,398.0	803.3
7	University of Minnesota	Lady Oak Fobes De Kol	22,063.0	794.0
8	University of California	California Agnes Colantha	21,801.4	788.4
9	Massachusetts Agricultural College	Concordia Pietertje	24,200.0	782.0
10	Iowa State College	Genoesea Belle Polkadot	20,816.2	732.9
11	New Jersey Agricultural College	College King Beauty	19,643.5	699.4
12	Purdue University	Segis Colantha Bakker	22,432.0	693.0
13	Pennsylvania State College	Lilith Gem Kolkluff	22,247.1	680.9
14	Colorado Agricultural College	Korndyke Sarcastic Jolie 2nd	22,717.8	666.3
15	North Dakota Agricultural College	Miss Ormsby Queen	17,718.7	640.1
16	Oregon Agricultural College	Princess Lill De Kol	16,249.0	598.0
17	West Virginia University	Schulings Beauty De Kol	15,002.0	522.9
18	University of Arkansas	Madison Jennie Friend	18,873.7	512.9
19	University of Maine	Sophie Shepherd De Kol 2nd	14,192.0	503.0
20	University of Tennessee	Violet Houwje Lady	14,470.1	490.3
21	University of Kentucky	Jr. De Kol Betsy	15,000.8	456.8
22	Clemson Agricultural College (S. C.)	Dotty Pontiac De Kol	13,160.7	427.7
23	University of Missouri	No entry		
24	University of Maryland	No Holsteins		

Holsteins—Continued

RANK	OWNER	COW	MILK	FAT
		Senior four year old class		
			pounds	*pounds*
1	University of Illinois	Juna Longfield Homestead	24,655.5	828.5
2	University of Missouri	Campus Josephine Galaxy	20,510.0	702.0
3	Kansas State Agricultural College	Carlotta Empress Fobes	24,547.0	694.2
4	Virginia Polytechnic Institute	Veeman Korndyke De Kol	19,620.0	687.0
5	University of California	Colantha 4th's Lad Mercedes	17,161.5	613.2
6	Connecticut Agricultural College	Minnie Fay Pietertje	20,822.8	607.5
7	Pennsylvania State College	Jessie Korndyke Verbelle	18,166.4	583.1
8	University of Nebraska	Quavia Lincoln	16,980.8	582.2
9	University of Maine	Pauline Pontiac Shepherd	15,759.0	581.0
10	University of Idaho	Idaho Favorite	18,367.8	574.6
11	University of Minnesota	Sita De Kol Pontiac	16,211.0	567.0
12	Iowa State College	Lucy Duchess De Kol	16,994.9	552.7
13	New Jersey Agricultural College	Rutgers' Duchess De Kol Korndyke	18,090.7	537.3
14	Purdue University	Colantha Paul Beet's Bakker	16,736.0	510.0
15	University of Arkansas	Dallas Friend Madison Jennie	14,604.0	497.1
16	Oregon Agricultural College	Oregon Korndaw	13,216.0	477.8
17	University of Tennessee	Winona Colantha 2nd	11,261.2	436.7
18	North Dakota Agricultural College	Cynthia Lass Ormsby	13,018.4	412.4
19	University of Kentucky	Duchess Rose De Kol 4th	10,481.2	357.6
20	Clemson Agricultural College (S. C.)	No entry		
21	Colorado Agricultural College	No entry		
22	University of West Virginia	No entry		
23	Massachusetts Agricultural College	No entry		
24	University of Maryland	No Holsteins		

Holsteins—Continued

RANK	OWNER	COW	MILK	FAT
		Junior four year old class		
			pounds	*pounds*
1	Virginia Polytechnic Institute	V. P. I. Veeman De Kol	17,333.0	764.0
2	University of Nebraska	Kittie Gerben Lincoln	18,382.1	718.0
3	University of California	Pietertje Lorena Korndyke	18,602.4	630.3
4	Connecticut Agricultural College	Dorinda Storrs De Kol	18,523.1	623.6
5	Massachusetts Agricultural College	Concord Woodcrest Fayne	17,680.0	622.0
6	University of Idaho	Ormsby Girl 2nd	16,724.6	621.4
7	University of Minnesota	Viola Longfield Sir Beets	19,893.0	567.0
8	Pennsylvania State College	Queen Pontiac Inka	14,747.0	567.0
9	University of West Virginia	Hulda Isabel Tula	17,422.3	538.0
10	Iowa State College	Belle Polkadot Pontiac Lass	16,823.3	536.6
11	University of Maine	Rebecca Empress Johanna	16,434.0	534.0
12	Purdue University	Princess Mercedes Segis	16,908.0	528.0
13	Colorado Agricultural College	Collins Chloe 3rd	16,703.7	518.0
14	Kansas State Agricultural College	Maid Henry Pontiac	14,502.0	514.7
15	University of Illinois	Pietertje Parthenca Sarcastic	15,937.2	510.7
16	Clemson Agricultural College (S. C.)	Mutual Maid Clothilde	16,100.0	497.1
17	Oregon Agricultural College	Loa Belle	13,045.0	496.9
18	University of Tennessee	Winona Colantha Lass	11,598.8	422.4
19	University of Kentucky	Aaggie Betsy Cornucopia	11,285.8	386.2
20	University of Arkansas	No entry		
21	North Dakota Agricultural College	No entry		
22	New Jersey Agricultural College	No entry		
23	University of Missouri	No entry		
24	University of Maryland	No Holsteins		

Holsteins—Continued

RANK	OWNER	COW	MILK	FAT
		Senior three year old class		
			pounds	*pounds*
1	University of California	California Agnes Colantha	19,409.6	689.9
2	University of Nebraska	Roxeva Lincoln	19,391.3	673.1
3	University of Tennessee	Violet Houwje Lady	15,408.6	630.4
4	Virginia Polytechnic Institute	V. P. I. Dione Korndyke Girl	19,984.0	600.0
5	Massachusetts Agricultural College	Beth Blossom Fayne	17,144.0	575.0
6	Kansas State Agricultural College	Lady Vale Walker	17,004.0	564.5
7	Pennsylvania State College	Jessie Natalie Korndyke Pontiac	16,365.6	530.4
8	Connecticut Agricultural College	Minnie Fay Pietertje	17,020.0	525.3
9	University of Minnesota	Anna Grace Lady De Kol	14,472.7	499.3
10	University of Missouri	Campus Lady Hengerveld Uno	13,256.0	496.0
11	Clemson Agricultural College (S. C.)	Helen Queen Ona	12,796.0	472.2
12	Iowa State College	Nutula Alcartra Pietertje Bakker	14,484.9	471.8
13	University of West Virginia	Violet Courtland Butterboy	11,990.0	461.9
14	Purdue University	Colantha Paul Beet's Bakker	15,037.0	445.0
15	Colorado Agricultural College	Korndyke Sarcastic Jolie 2nd	14,714.9	428.8
16	North Dakota Agricultural College	Miss Ormsby Madeline	12,531.7	419.8
17	Oregon Agricultural College	Hazel Queen	13,592.0	402.5
18	University of Idaho	Cinderella Korndyke Hengerveld	10,290.2	366.6
19	University of Arkansas	No entry		
20	University of Illinois	No entry		
21	New Jersey Agricultural College	No entry		
22	University of Kentucky	No entry		
23	University of Maine	No entry		
24	University of Maryland	No Holsteins		

Holsteins—Continued

RANK	OWNER	COW	MILK	FAT
		Junior three year old class		
			pounds	*pounds*
1	University of Illinois	Illini Dulcina De Kol	17,755.4	719.7
2	Virginia Polytechnic Institute	V. P. I. Mineta	16,055.0	673.0
3	Connecticut Agricultural College	Pietertje De Kol Burke 2nd	18,850.2	661.4
4	New Jersey Agricultural College	Rutgers' Beauty Korndyke	16,307.2	628.5
5	University of Nebraska	Katy Gerben	18,573.4	620.4
6	University of Minnesota	Cyme Aaggie Beets of Shady Nook	18,611.0	611.0
7	University of California	California Juliana De Kol 2nd	16,618.1	598.4
8	Pennsylvania State College	Jessie Colantha Pontiac Korndyke	18,719.9	569.2
9	Iowa State College	Princess Pontiac of Ames	14,787.3	513.8
10	University of Idaho	Idaho Violet Daisy De Kol	14,358.6	509.4
11	Massachusetts Agricultural College	Piebe Clay Hengerveld Johanna	16,622.0	508.0
12	University of Arkansas	Naudine Pontiac Snowball Netherlands 2nd	14,672.0	474.9
13	University of West Virginia	Schulings' Beauty De Kol	15,115.1	469.2
14	Kansas State Agricultural College	Canary College Josephine	13,581.0	449.9
15	University of Tennessee	Winona Colantha Lass	9,859.2	352.0
16	North Dakota Agricultural College	Ormsby Lass Hengerveld	10,434.9	351.5
17	Clemson Agricultural College (S. C.)	McKinley Tehee Clothilde	11,326.0	299.4
18	Colorado Agricultural College	No entry		
19	University of Kentucky	No entry		
20	University of Maine	No entry		
21	University of Missouri	No entry		
22	Oregon Agricultural College	No entry		
23	Purdue University	No entry		
24	University of Maryland	No Holsteins		

Holsteins—Continued

RANK	OWNER	COW	MILK	FAT
		Senior two year old class		
			pounds	*pounds*
1	University of California	California Pietertje Bloom Mead	19,985.0	722.2
2	University of Illinois	Illini Homestead Parthenia Girl	20,393.5	717.0
3	Virginia Polytechnic Institute	V. P. I. Veeman Korndyke De Kol	20,696.0	675.0
4	University of Nebraska	Roxeva Lincoln	17,625.5	586.4
5	Kansas State Agricultural College	Inka Hijlaard Walker	16,058.0	585.4
6	Iowa State College	Miss Fayne Ames Gamma	17,068.5	571.7
7	University of Minnesota	Colantha Ormsby Korndyke Monroe	15,224.6	566.5
8	Pennsylvania State College	Keystone De Kol Pietertje Beets	16,182.8	562.4
9	University of Tennessee	Lady Woodcrest Colantha Lad	13,293.6	504.5
10	University of Idaho	Idaho Segis Ormsby Girl	13,870.9	478.4
11	Purdue University	Inka Colantha Segis	15,631.0	465.0
12	Colorado Agricultural College	Barbara Duchess Clyde 3rd	14,398.9	456.1
13	Oregon Agricultural College	Oregon Daw De Kol	12,618.0	452.9
14	Connecticut Agricultural College	Dorinda Storrs De Kol	12,846.0	441.5
15	University of Arkansas	Arkansas Tidy Jennie Beets	13,475.0	424.6
16	North Dakota Agricultural College	Miss Ormsby Queen Farewell	12,473.0	422.0
17	Massachusetts Agricultural College	Countess Chloe	12,037.0	401.0
18	Clemson Agricultural College (S. C.)	Mutual Maid Clothilde	11,653.0	370.6
19	University of Missouri	Campus Lady Hengerveld Dorabel	12,752.0	366.0
20	University of Kentucky	No entry		
21	University of Maine	No entry		
22	New Jersey Agricultural College	No entry		
23	University of West Virginia	No entry		
24	University of Maryland	No Holsteins		

Holsteins—Continued

RANK	OWNER	COW	MILK	FAT
		Junior two year old class		
			pounds	*pounds*
1	University of Minnesota	Fairy Aaggie Korndyke Colantha	20,005.5	696.8
2	University of Nebraska	Varsity Derby Sultana	19,555.8	693.5
3	University of Illinois	Illini Tritomia Tina Clay	18,909.4	592.9
4	Virginia Polytechnic Institute	V. P. I. Dione De Kol	12,444.1	544.0
5	New Jersey Agricultural College	Rutgers' Valdessa Beauty	15,590.5	527.7
6	Massachusetts Agricultural College	Concordia Fayne Pietertje	14,870.0	486.0
7	University of Idaho	Idaho Segis Colantha	13,004.9	470.4
8	University of California	Pietertje Bloom 2nd	13,216.1	460.7
9	Pennsylvania State College	Pennstates Ormsby Pontiac	13,181.5	457.4
10	Iowa State College	Johanna Fayne Pride of Ames	14,586.0	455.7
11	University of Arkansas	Arkansas Segis Topsy	14,429.0	453.2
12	Oregon Agricultural College	Lois Lill De Kol	11,865.0	433.0
13	Purdue University	Purdue Segis Colantha Princess	14,981.0	416.0
14	University of Missouri	Campus Lady Hengerveld Bluebell	11,127.0	412.0
15	Kansas State Agricultural College	Netherland Omnis Walker	12,243.0	411.5
16	North Dakota Agricultural College	Miss Ormsby Hengerveld	11,715.0	399.8
17	Clemson Agricultural College (S. C.)	Helen Queen Minnehaha	11,508.7	372.8
18	University of Kentucky	Duchess Pietertje Rose	10,132.2	341.1
19	University of Tennessee	Houwtje Pietertje De Kol Lady	8,788.3	318.0
20	Connecticut Agricultural College	De Kol Hubbard Pietertje 2nd	8,156.4	306.1
21	University of West Virginia	Queen Klassje De Kol	8,892.4	297.8
22*	Colorado Agricultural College	Chloe Korndyke Clothilde	9,258.6	292.6
23	University of Maine	No entry		
24	University of Maryland	No Holsteins		

* Senior yearling.

Jerseys

RANK	OWNER	COW	MILK	FAT
		Mature class		
			pounds	*pounds*
1	University of Illinois	Majesty's Iris	17,469.7	955.8
2	University of California	Interested Jap's Santa	15,569.0	940.7
3	Oregon Agricultural College	Old Man's Darling	14,130.0	818.0
4	Connecticut Agricultural College	Beaudesert Pet	13,870.1	762.8
5	Purdue University	Purdue's Golden Estelle	14,052.0	748.0
6	University of Maine	Lassie of M. F.	10,000.0	690.0
7	Iowa State College	Figgis 28th of Hood Farm	12,131.0	675.0
8	University of Minnesota	Lads' Goldy Y	12,187.0	669.0
9	Kansas State College	The Owl's Design	14,606.0	650.1
10	Massachusetts Agricultural College	Jeanette of Hebron	12,487.0	643.0
11	North Dakota Agricultural College	Roxana Maid	11,981.1	640.2
12	University of Tennessee	Major's Fancy Tormentress	10,484.0	632.0
13	University of Nebraska	Bona Lincoln	12,691.0	628.0
14	New Jersey Agricultural College	Lady Leifburrow of Oak Hill	11,277.5	624.5
15	Clemson Agricultural College (S. C.)	Plumage Inez	10,202.0	559.3
16	University of Arkansas	Cynthia's Golden Babe	10,798.5	550.8
17	University of Missouri	Campus Virginia J	8,963.0	491.0
18	University of Kentucky	Baronette's Lady Dean	7,778.8	442.4
19	Colorado Agricultural College	No entry		
20	University of Idaho	No entry		
21	Pennsylvania State College	No entry		
22	Virginia Polytechnic Institute	No entry		
23	West Virginia University	No entry		
24	University of Maryland	No Jerseys		
		Senior four year old class		
1	Massachusetts Agricultural College	Lass Princess	10,808.0	701.0
2	University of Maine	Lakeland's Lassie	11,700.0	660.0
3	Iowa State College	Princess Figgis of Ames	11,408.0	641.8
4	University of Nebraska	Reba Lincoln	10,667.0	618.0

Jerseys—Continued

RANK	OWNER	COW	MILK	FAT
		Senior four year old class—*Continued*		
			pounds	*pounds*
5	Oregon Agricultural College	Sophie's Golden Glow Beauty	10,827.0	617.7
6	Kansas State Agricultural College	Khoi	12,518.0	615.2
7	University of Missouri	Campus Virginia L	9,387.0	603.0
8	New Jersey Agricultural College	Rutger's Oxford Marvel	13,984.0	591.5
9	University of California	California Jap's Nora	10,528.0	546.6
10	University of Arkansas	Pearl's Alpha	10,550.0	531.0
11	Connecticut Agricultural College	Storr's Select Butterfly	8,723.2	509.7
12	Purdue University	Purdue's Sayda	9,119.0	467.0
13	University of Tennessee	Fancy Evolution	6,426.0	356.0
14	University of Kentucky	Hebron's Lady	6,366.2	352.5
15	Clemson Agricultural College	University Lad's Violet	6,975.4	352.32
16	Colorado Agricultural College	No entry		
17	University of Idaho	No entry		
18	University of Illinois	No entry		
19	University of Minnesota	No entry		
20	North Dakota Agricultural College	No entry		
21	Pennsylvania State College	No entry		
22	Virginia Polytechnic Institute	No entry		
23	West Virginia University	No entry		
24	University of Maryland	No Jerseys		
		Junior four year old class		
1	University of California	Interested Jap's Santa	13,308.5	805.72
2	University of Missouri	Campus Virginia Q	11,154.0	623.0
3	University of Maine	Poet's Golden Flora	11,355.0	610.0
4	University of Kentucky	Dollie's Valentine	10,218.0	578.0
5	Iowa State College	Raleigh's Maiden of Ames	12,107.0	543.8
6	University of Nebraska	Ella Lincoln	10,850.0	531.0
7	Purdue University	Lady Sayda Mary	9,167.0	531.0
8	Kansas State Agricultural College	Docter's Lady Love.	9,913.0	495.1
9	Connecticut Agricultural College	Storrs' Robin Butterfly	8,627.0	490.1

Jerseys—Continued

RANK	OWNER	COW	MILK	FAT
		Junior four year class—*Continued*		
			pounds	*pounds*
10	University of Idaho	Eagle's Golden Princess	5,821.1	349.3
11	University of Arkansas	Eminent's Rosaline	6,930.0	336.5
12	Colorado Agricultural College	No entry		
13	University of Illinois	No entry		
14	Massachusetts Agricultural College	No entry		
15	University of Minnesota	No entry		
16	New Jersey Agricultural College	No entry		
17	North Dakota Agricultural College	No entry		
18	Oregon Agriculture College	No entry		
19	Pennsylvania State College	No entry		
20	Clemson Agricultural College (S. C.)	No entry		
21	University of Tennessee	No entry		
22	Virginia Polytechnic Institute	No entry		
23	West Virginia University	No entry		
24	University of Maryland	No Jerseys		
		Senior three year old class		
1	Oregon Agricultural College	Oregon Maple G	10,776.0	650.2
2	Purdue University	Estelle Joan	10,632.0	633.0
3	University of Illinois	Volunteer's Juliet	12,286.0	614.1
4	University of California	California Inside	9,991.8	590.8
5	University of Maine	Lakeland's Lassie	9,391.0	556.0
6	University of Arkansas	Pearl's Alpha	10,239.6	553.84
7	Kansas Agricultural College	Sultana's Jolly Tipsy	9,201.0	541.3
8	Iowa State College	Ames Financial Beauty	10,381.0	529.6
9	University of Nebraska	Ula Lincoln	9,311.0	520.0
10	New Jersey Agricultural College	Mandy Matchless Queen	8,666.3	510.1
11	Connecticut Agricultural College	Copper Butterfly 2nd	8,837.5	454.0

Jerseys—Continued

RANK	OWNER	COW	MILK	FAT
		Senior three year old class—*Continued*		
			pounds	*pounds*
12	Clemson Agricultural College (S. C.)	University Plymouth Belle	8,872.7	450.3
13	West Virginia University	Nellie's Little Queenie	9,142.9	447.7
14	University of Idaho	Eagle's Jersey Queen	6,484.9	395.3
15	University of Kentucky	Raleigh's Countess	7,871.3	378.8
16	Colorado Agricultural College	No entry		
17	Massachusetts Agricultural College	No entry		
18	University of Minnesota	No entry		
19	University of Missouri	No entry		
20	Pennsylvania State College	No entry		
21	University of Tennessee	No entry		
22	North Dakota Agricultural College	No entry		
23	Virginia Polytechnic Institute	No entry		
24	University of Maryland	No Jerseys		
		Junior three year old class		
1	University of Minnesota	Trill Pogis of Lily Dale	12,159.0	682.0
2	Connecticut Agricultural College	Beaudesert Pet	11,806.0	610.0
3	University of Missouri	Campus Virginia Q	8,294.0	468.0
4	University of California	Mermaiden Fern 2nd	9,110.0	466.0
5	Iowa State College	Pogis Belle of Ames	9,320.0	456.8
6	Purdue University	Purdue's Evening Primrose	9,858.0	454.0
7	Clemson Agricultural College	Pogis Princess of P. V. Farms	10,005.0	435.5
8	North Dakota Agricultural College	Dodo's Silverine	7,092.9	428.9
9	University of Arkansas	Eminent's Cynthia	7,026.6	424.4
10	Kansas State Agricultural College	Sultana's Noble Revelation	7,429.0	413.7
11	University of Nebraska	Elaine Lincoln	7,220.0	408.0
12	Oregon Agricultural College	Oregon Maple F	7,304.0	399.0
13	University of Kentucky	Baronette's Golden McEachen	6,958.8	397.3

Jerseys—Continued

RANK	OWNER	COW	MILK	FAT
		Junior three year old class—*Continued*		
			pounds	*pounds*
14	West Virginia University	Emma's Pleasure	8,026.0	387.8
15	University of Tennessee	Cherokee Anne	6,589.0	346.2
16	University of Idaho	Owl's Traviata of Waikiki	6,414.0	335.4
17	Colorado Agricultural College	No entry		
18	University of Illinois	No entry		
19	University of Maine	No entry		
20	Massachusetts Agricultural College	No entry		
21	New Jersey Agricultural College	No entry		
22	Pennsylvania State College	No entry		
23	Virginia Polytechnic Institute	No entry		
24	University of Maryland	No Jerseys		
		Senior two year old class		
1	University of California	Interested Jap's Santa	9,051.0	588.2
2	Oregon Agricultural College	Oregon Tormentor Glow	10,710.0	587.6
3	New Jersey Agricultural College	Rutger's Fern Clara	9,625.0	557.4
4	University of Missouri	Campus Virginia T	9,086.0	489.0
5	Pennsylvania State College	Pogis Romona of Old Forge	8,090.5	476.9
6	University of Kentucky	Hebron's Betty	8,334.0	414.5
7	Iowa State College	Raleigh's Maiden of Ames	8,926.0	404.6
8	University of Illinois	Volunteer's Juliet	7,156.0	370.7
9	Clemson Agricultural College	Plymouth Queen Nora	6,894.6	362.4
10	Connecticut Agricultural College	Storrs Althea	6,733.1	340.6
11	University of Nebraska	Glory Lincoln	5,561.0	336.0
12	University of Tennessee	Jolly's Eminent Isis	6,408.0	333.6
13	North Dakota Agricultural College	College Marietta	7,067.5	327.1
14	University of Arkansas	Cynthia's Golden Babe	6,428.1	322.1
15	University of Minnesota	Elayne Oxford of Lily Dale	5,982.0	288.0
16	Colorado Agricultural College	No entry		

Jerseys—Continued

RANK	OWNER	COW	MILK	FAT
		Senior two year old class—*Continued*		
			pounds	*pounds*
17	University of Idaho	No entry		
18	Kansas State Agricultural College	No entry		
19	University of Maine	No entry		
20	Massachusetts Agricultural College	No entry		
21	Purdue University	No entry		
22	Virginia Polytechnic Instiute	No entry		
23	West Virginia University	No entry		
24	University of Maryland	No Jerseys		
		Junior two year old class		
1	Pennsylvania State College	Penstate's Torono's Blacky	9,854.7	532.3
2	Oregon Agricultural College	Oregon Sweet Glow	9,740.0	525.5
3	University of Missouri	Campus Virginia S	7,829.0	492.0
4	Iowa State College	Ames Financial Beauty	9,611.0	475.2
5	University of California	California's Owl's Rose	7,773.6	475.1
6	University of Nebraska	Elma Lincoln	9,185.0	468.0
7	Kansas State Agricultural College	Sultana's Jolly Tipsy	7,940.0	464.9
8	University of Illinois	Majesty's Iris 2nd	8,024.4	450.9
9	University of Idaho	Idaho Blossom	7,650.7	443.2
10	University of Kentucky	Hebron's Tera B	8,759.6	425.7
11	Purdue University	Purdue's Evening Primrose	8,799.0	419.0
12	Clemson Agricultural College	Blue Foxes' Golden Trover	9,141.0	414.3
13	Connecticut Agricultual College	Copper Butterfly 2nd	7.770.7	403.4
14	North Dakota Agricultural College	Roxanna Daisy	7,338.6	376.2
15	University of Arkansas	Arkansas Fairy 2nd	7,713.0	373.2
16	University of Minnesota	Tylene Oxford of Lily Dale	6,195.0	352.0
17	Colorado Agricultural College	Sans Aloi Rosette	6,623.0	315.8
18	University of Maine	Lassie of M. F.	4,596.0	306.0

Jerseys—Continued

RANK	OWNER	COW	MILK	FAT
		Junior two year old class—*Continued*		
			pounds	*pounds*
19	University of Tennessee	Blue Belle of Meadow Brook	4,902.0	261.2
20	Massachusetts Agricultural College	No entry		
21	New Jersey Agricultual College	No entry		
22	Virginia Polytechnic Institute	No entry		
23	West Virginia University	No entry		
24	University of Maryland	No Jerseys		
		Guernseys		
		Mature cow class		
1	University of Illinois	Yeksarose 4th	14,527.1	753.7
2	University of California	Fern Ridge Rose	17,062.0	729.5
3	Massachusetts Agricultual College	Earl's Nantaska	13,355.0	704.0
4	Oregon Agricultural College	May Rose IX of la Masse	13,174.0	696.1
5	Kansas State Agricultural College	Imp Pallas	13,240.0	624.8
6	University of Minnesota	Yexeve of Ash Cove	12,188.0	619.0
7	Iowa State College	Miss of St. Louis 2nd	12,101.5	618.7
8	University of Nebraska	Squire des Blicqs's Helene	11,346.0	592.0
9	University of Maryland	Elfleda of Haddon	14,093.0	583.0
10	Connecticut Agricultural College	Lorin Masher	11,357.4	558.7
11	North Dakota Agricultural College	Yeksa Sunbeam 2nd	9,924.9	487.4
12	University of Maine	Canada's Crensa 2nd	10,631.0	470.0
13	Clemson Agricultural College (S. C.)	No entry		
14	Colorado Agricultural College	No entry		
15	University of Kentucky	No entry		
16	New Jersey Agr. College	No entry		
17	University of Missouri	No entry		
18	Pennsylvania State College	No entry		

Guernseys—Continued

RANK	OWNER	COW	MILK	FAT
		Mature cow class—*Continued*		
			pounds	*pounds*
19	Purdue University (Ind.)	No entry		
20	Virginia Polytechnic Institute	No entry		
21	West Virginia University	No Guernseys		
22	University of Idaho	No Guernseys		
23	University of Arkansas	No Guernseys		
24	University of Tennessee	No Guernseys		
		Senior four year old class		
1	Massachusetts Agricultural College	College King's Nantaska	14,811.0	684.0
2	Iowa State College	Rouge II of the Brickfield	12,205.9	608.1
3	North Dakota Agricultural College	Yeksa Proud	7,936.0	461.3
4	University of Maryland	Procida's Poinsetta	9,952.0	425.0
5	Purdue University	Imp. Rosetta III of Annevilles	8,879.0	422.0
6	Oregon Agricultural College	Alcina of Upper Freehold	7,359.0	390.7
7	Colorado Agricultural College	Orlette's Fancy Lassie	8,017.0	381.9
8	Connecticut Agricultural College	Eurotas Mansfield 2nd	9,225.0	359.5
9	University of Nebraska	Princess Lincoln	7,849.0	347.0
10	University of California	No entry		
11	Clemson Agricultural College	No entry		
12	University of Illinois	No entry		
13	Kansas State Agricultural College	No entry		
14	University of Kentucky	No entry		
15	University of Maine	No entry		
16	University of Minnesota	No entry		
17	University of Missouri	No entry		
18	New Jersey Agricultural College	No entry		
19	Pennsylvania State College	No entry		
20	Virginia Polytechnic Institute	No entry		
21	University of Arkansas	No Guernseys		

Guernseys—Continued

RANK	OWNER	COW	MILK	FAT
		Senior four year old class—*Continued*		
			pounds	*pounds*
22	University of Idaho	No Guernseys		
23	University of Tennessee	No Guernseys		
24	University of West Virginia	No Guernseys		
		Junior four year old class		
1	Pennsylvania State College	Delza 3rd	10,608.7	542.5
2	Kansas State Agricultural College	Imp. Lucy II of Carbinez	10,599.0	532.7
3	University of Maine	Lake Grove Lucretia	8,228.0	452.0
4	University of Illinois	Jeydale 3rd	8,797.6	430.0
5	Iowa State College	Imp. Princess 2nd of the Blicqs	8,853.3	428.7
6	University of Nebraska	Pearl Lincoln	9,408.0	428.0
7	University of California	Fern Ridge Pearl	8,241.5	398.5
8	Oregon Agricultural College	Little Nell of Foothill's Farm	7,628.0	331.8
9	Clemson Agricultural College	No entry		
10	Colorado Agricultural College	No entry		
11	Connecticut Agricultural College	No entry		
12	University of Kentucky	No entry		
13	University of Maryland	No entry		
14	Massachusetts Agricultural College	No entry		
15	University of Minnesota	No entry		
16	University of Missouri	No entry		
17	New Jersey Agricultural College	No entry		
18	North Dakota Agricultural College	No entry		
19	Purdue University	No entry		
20	Virginia Polytechnic Institute	No entry		
21	University of Arkansas	No Guernseys		
22	University of Idaho	No Guernseys		
23	University of Tennessee	No Guernseys		
24	University of West Virginia	No Guernseys		

Guernseys—Con[illegible]

RANK	OWNER	[illegible]W	MILK	FAT
		Senior three year [illegible] class		
			pounds	*pounds*
1	Massachusetts Agricultural College	Nantaska Beauty	11,359.0	608.0
2	University of Illinois	Yeksarose 4th	11,904.4	602.7
3	University of Nebraska	Squire des Blicqs's Helene	10,577.0	559.0
4	Connecticut Agricultural College	Lorin Masher	10,632.4	529.3
5	Colorado Agricultural College	Dolly Bonits	10,044.2	476.9
6	Iowa State College	Imp. Parson's Spot III	9,002.6	411.3
7	Kansas State Agricultural College	Imp. Donnington Happy Girl 7th	7,598.0	374.4
8	University of Maryland	Peggy of Rossbourg	7,311.0	352.0
9	University of California	No entry		
10	Clemson Agricultural College	No entry		
11	University of Kentucky	No entry		
12	University of Maine	No entry		
13	University of Minnesota	No entry		
14	University of Missouri	No entry		
15	North Dakota Agricultural College	No entry		
16	Oregon Agricultural College	No entry		
17	Pennsylvania State College	No entry		
18	Purdue University	No entry		
19	Virginia Polytechnic Institute	No entry		
20	New Jersey Agricultural College	No entry		
21	University of Arkansas	No Guernseys		
22	University of Idaho	No Guernseys		
23	University of Tennessee	No Guernseys		
24	University of West Virginia	No Guernseys		
		Junior three year old class		
1	University of Nebraska	Squire des Blicqs's Ramona	10,672.0	501.0
2	University of Maine	Canada's Crensa 3rd	8,611.0	438.0
3	University of California	Fern Ridge Rose	9,928.8	436.4

nseys—Continued

RANK	OWNER	COW	MILK	FAT
		Junior three year old class—*Continued*		
			pounds	pounds
4	Connecticut Agricultural College	Lute Storr's Masher	8,029.7	433.3
5	University of Maryland	Procida of Rossbourg	9,412.0	422.0
6	Purdue University	Imp. Betty's Prize	7,649.0	391.0
7	North Dakota Agricultural College	Yeksa Proud	6,913.0	382.4
8	Iowa State College	Miss St. Louis of Ames	6,920.9	376.7
9	Oregon Agricultural College	Freesia's Corona Lass	7,872.0	363.4
10	Clemson Agricultural College	No entry		
11	Colorado Agricultural College	No entry		
12	University of Illinois	No entry		
13	Kansas State Agricultural College	No entry		
14	University of Kentucky	No entry		
15	Massachusetts Agricultural College	No entry		
16	University of Minnesota	No entry		
17	University of Missouri	No entry		
18	New Jersey Agricultural College	No entry		
19	Pennsylvania State College	No entry		
20	Virginia Polytechnic College	No entry		
21	University of Arkansas	No Guernseys		
22	University of Idaho	No Guernseys		
23	University of Tennessee	No Guernseys		
24	University of West Virginia	No Guernseys		
		Senior two year old class		
1	Iowa State College	Imp. Rouge II of the Brickfield	10,963.0	612.5
2	Kansas State Agricultural College	Bernice's Countess 2nd	9,991.0	521.8
3	Massachusetts Agricultural College	Imp. Bijou of Linda Vista	9,507.0	485.0
4	University of Maine	Crensa's Belle	7,502.0	444.0

Guernseys—Continued

RANK	OWNER	COW	MILK	FAT
		Senior two year old class—*Continued*		
			pounds	*pounds*
5	Clemson Agricultural College	Pet's Soso	7,523.8	423.0
6	University of Minnesota	Lil of Beirnetown	8,313.0	375.0
7	North Dakota Agricultural College	Yeksa Sunburst 2nd	7,510.4	354.1
8	Purdue University	Imp. Jeanette of Seignerrie	6,879.0	354.0
9	University of Maryland	Selma of Rossbourg	7,091.0	325.0
10	Connecticut Agricultural College	Eurotes Mansfield 2nd	6,911.4	294.8
11	University of California	No entry		
12	University of Colorado	No entry		
13	University of Illinois	No entry		
14	University of Kentucky	No entry		
15	University of Missouri	No entry		
16	New Jersey Agricultural College	No entry		
17	University of Nebraska	No entry		
18	Oregon Agricultural College	No entry		
19	Pennsylvania State College	No entry		
20	Virginia Polytechnic Institute	No entry		
21	University of Arkansas	No Guernseys		
22	University of Idaho	No Guernseys		
23	University of Tennessee	No Guernseys		
24	University of West Virginia	No Guernseys		
		Junior two year old class		
1	Clemson Agricultural College (S. C.)	May King's Alvada	12,294.9	538.0
2	Iowa State College	Ames Rouge Lassie	8,966.6	512.9
3	University of Maryland	Royal Lady of Oakhurst	9,008.0	507.0
4	University of Illinois	Miranda Pride of Oberland	9,360.9	505.2
5	University of Minnesota	Le Gele's Prairie Side Bell	10,124.0	474.0
6	University of Kentucky	Ladbelle of Sunnyside	7,596.3	434.3
7	Pennsylvania State College	Glow of Cloverdell	8,741.1	424.7
8	Kansas State Agricultural College	Imp. Lucy II of Corbinez	8,133.0	422.9

Guernseys—Continued

RANK	OWNER	COW	MILK	FAT
		Junior two year old class—*Continued*		
			pounds	*pounds*
9	University of California	California Pearl	7,652.5	389.7
10	University of Nebraska	Squire des Blicqs's Helene	7,602.0	383.0
11	Connecticut Agricultural College	Lute Storr's Masher	7,067.0	356.6
12	North Dakota Agricultural College	King Masher's Martha	7,111.6	353.3
13	Colorado Agricultural College	Orlette's Fancy Lassie	6,322.1	341.6
14	Purdue University	Imp. Betty's Prize	6,314.0	316.0
15	Oregon Agricultural College	Freesia's Corona Lass of Iowa	6,711.0	298.0
16	University of Maine	No entry		
17	Massachusetts Agricultural College	No entry		
18	University of Missouri	No entry		
19	New Jersey Agr. College	No entry		
20	Virginia Polytechnic Institute	No entry		
21	University of Arkansas	No Guernseys		
22	University of Idaho	No Guernseys		
23	University of Tennessee	No Guernseys		
24	University of West Virginia	No Guernseys		

Ayrshires

Mature cow class

1	Kansas State Agricultural College	Canary Bell	19,863.0	744.51
2	University of Illinois	Bluebell of the Plains	15,122.0	724.53
3	Massachusetts Agricultural College	Spot Fox	17,749.0	634.0
4	Connecticut Agricultural College	Mauchlin Snowdrop 2nd	14,680.0	618.53
5	University of Nebraska	Bonnie Jean	13,062.0	579.0
6	University of California	Willowmoor Cherry	12,601.0	551.4
7	Purdue University	Bangora's Fizzaway Pearl	15,000.0	545.0
8	Iowa State College	Cavalier's Belle of Spring City	13,434.0	515.2
9	University of Arkansas	College Lass	11,393.0	499.0
10	Oregon Agricultural College	Willowmoor White Pride B	12,234.0	482.4

Ayrshires—Continued

RANK	OWNER	COW	MILK	FAT
		Mature cow class—*Continued*		
			pounds	*pounds*
11	West Virginia University	Molly Ostrum	10,762.2	429.7
12	University of Minnesota			420.0
13	University of Maine	Envious Athenia	9,337.0	392.0
14	University of Maryland	Salome of Spring Valley	11,600.0	390.0
15	New Jersey Agricultural College	No entry		
16	Pennsylvania State College	No entry		
17	University of Missouri	No entry		
18	Virginia Polytechnic Institute	No entry		
19	Clemson Agricultural College (S. C.)	No Ayrshires		
20	Colorado Agricultural College	No Ayrshires		
21	University of Idaho	No Ayrshires		
22	University of Kentucky	No Ayreshires		
23	University of Tennessee	No Ayrshires		
24	North Dakota Agricultural College	No Ayrshires		
		Senior four year old class		
1	Purdue University	Bangora's Fizzaway	14,983.0	532.0
2	Iowa State College	Robin Hood Cavalier's Lass	12,265.0	529.4
3	Connecticut Agricultural College	Mauchlin Whitehill True	11,894.6	518.5
4	Kansas State Agricultural College	Elisabeth of Juneau	14,953.0	480.9
5	Oregon Agricultural College	Willowmoor Douglas	11,454.0	463.8
6	University of California	Willowmoor Cherry	10,465.0	445.0
7	University of Illinois	Violet of the Plains	10,713.0	381.8
8	University of Arkansas	No entry		
9	University of Maine	No entry		
10	University of Maryland	No entry		
11	Massachusetts Agricultural College	No entry		
12	University of Minnesota	No entry		
13	New Jersey Agricultural College	No entry		
14	University of Nebraska	No entry		

Ayrshires—Continued

RANK	OWNER	COW	MILK	FAT
		Senior four year old class—*Continued*		
			pounds	*pounds*
15	Pennsylvania State College	No entry		
16	University of Missouri	No entry		
17	University of West Virginia	No entry		
18	Virginia Polytechnic Institute	No entry		
19	Clemson Agricultural College	No Ayrshires		
20	Colorado Agricultural College	No Ayrshires		
21	University of Idaho	No Ayrshires		
22	University of Kentucky	No Ayrshires		
23	University of Tennessee	No Ayrshires		
24	North Dakota Agricultural College	No Ayrshires		
		Junior four year old class		
1	Massachusetts Agricultural College	Victor's Beauty Lass	15,980.0	666.0
2	Kansas State Agricultural College	Bangora 2nd's Good Gift	13,695.0	547.6
3	Connecticut Agricultural College	Mauchlin Snowdrop 2nd	11,537.0	494.0
4	University of Maryland	Kitty Maes	11,910.0	491.0
5	University of Arkansas	Beauty's Aldena	11,117.0	457.8
6	Iowa State College	Barclay's Flash Girl	10,934.0	427.1
7	University of Nebraska	Celeaste Lincoln	8,220.0	377.0
8	Oregon Agricultural College	Mabel Chalmers	10,083.0	352.0
9	University of California	California Cherry	10,486.0	351.2
10	University of Illinois	Illini Bluebell of the Plains	8,241.0	340.6
11	University of Minnesota	No entry		
12	University of Maine	No entry		
13	New Jersey State College	No entry		
14	Pennsylvania State College	No entry		
15	Purdue University	No entry		
16	University of Missouri	No entry		
17	University of West Virginia	No entry		

Ayrshires—Continued

RANK	OWNER	COW	MILK	FAT
		Junior four year old class—*Continued*		
			pounds	*pounds*
18	Virginia Polytechnic Institute	No entry		
19	Clemson Agricultural College	No Ayrshires		
20	Colorado Agricultural College	No Ayrshires		
21	University of Idaho	No Ayrshires		
22	University of Kentucky	No Ayrshires		
23	University of Tennessee	No Ayrshires		
24	North Dakota Agricultural College	No Ayrshires		
		Senior three year old class		
1	Kansas State Agricultural College	Bangora's Melrose	14,515.0	568.1
2	Massachusetts Agricultural College	Norena's Violet	13,347.0	559.0
3	University of Maine	Majestic Netta	10,000.0	460.0
4	Connecticut Agricultural College	Mauchlin Whitehill True	8,739.2	428.6
5	Oregon Agricultural College	College Netherall Blonde	10,112.0	418.8
6	Pennsylvania State College	Penstates Finlayston Snowdrop	9,274.0	412.2
7	University of Arkansas	No entry		
8	University of California	No entry		
9	University of Illinois	No entry		
10	Iowa State College	No entry		
11	University of Maryland	No entry		
12	University of Minnesota	No entry		
13	New Jersey Agricultural College	No entry		
14	Purdue University (Indiana)	No entry		
15	University of Nebraska	No entry		
16	University of Missouri	No entry		
17	University of West Virginia	No entry		
18	Virginia Polytechnic Institute	No entry		

Ayrshires—Continued

RANK	OWNER	COW	MILK	FAT
		Senior three year old class—*Continued*		
			pounds	pounds
19	Clemson Agricultural College (S. C.)	No Ayrshires		
20	Colorado Agricultural College	No Ayrshires		
21	University of Idaho	No Ayrshires		
22	University of Kentucky	No Ayrshires		
23	University of Tennessee	No Ayrshires		
24	North Dakota Agricultural College	No Ayrshires		
		Junior three year old class		
1	Iowa State College	Cavalier's Robin Hood Lass	9,830.0	472.4
2	Oregon Agricultural College	Willowmoor White Pride B	10,736.0	441.8
3	Massachusetts Agricultural College	Beauty Chevlynn	10,387.0	433.0
4	University of Nebraska	Clemie Spencer	10,276.0	392.0
5	University of Maine	Wilson Valley Rhoda	8,991.0	370.0
6	Connecticut Agricultural College	Mauchlin Snowdrop 2nd	8,359.0	365.4
7	Purdue University	Bangora Pearl Croft	9,563.0	347.0
8	University of California	California Barcheskie	8,105.0	318.6
9	Kansas State Agricultural College	Kansas Croft Maude	8,442.0	314.9
10	University of Illinois	Cornflower	7,043.0	311.2
11	University of Arkansas	College Lass	7,095.0	308.4
12	University of Maryland	No entry		
13	University of Minnesota	No entry		
14	New Jersey Agricultural College	No entry		
15	Pennsylvania State College	No entry		
16	University of Missouri	No entry		
17	University of West Virginia	No entry		
18	Virginia Polytechnic Institute	No entry		
19	Clemson Agricultural College (S. C.)	No Ayrshires		
20	Colorado Agricultural College	No Ayrshires		

Ayrshires—Continued

RANK	OWNER	COW	MILK	FAT
		Junior three year old class—*Continued*		
			pounds	*pounds*
21	University of Idaho	No Ayrshires		
22	University of Kentucky	No Ayrshires		
23	University of Tennessee	No Ayrshires		
24	North Dakota Agricultural College	No Ayrshires		
		Senior two year old class		
1	University of Maryland	Juno of Rossbourg	12,371.0	537.0
2	Pennsylvania State College	Penstates Finlayston Bell	10,644.0	529.0
3	Massachusetts Agricultural College	Victor's Beauty Lass	12,664.0	521.0
4	Kansas State Agricultural College	Cavalier's Croft Melrose	12,499.0	467.5
5	Oregon Agricultural College	Oregon Panetta B	11,295.0	452.1
6	University of Missouri	Campus Canary E	8,850.0	392.0
7	University of Nebraska	Celeaste Lincoln	9,504.0	377.0
8	University of Maine	Majestic Netta	8,010.0	322.0
9	University of Illinois	Illini Bluebell of the Plains	7,281.0	314.7
10	University of Arkansas	No entry		
11	Connecticut Agricultural College	No entry		
12	University of California	No entry		
13	Iowa State College	No entry		
14	University of Minnesota	No entry		
15	New Jersey Agricultural College	No entry		
16	Purdue University	No entry		
17	Virginia Polytechnic Institute	No entry		
18	University of West Virginia	No entry		
19	Clemson Agricultural College	No Ayrshires		
20	Colorado Agricultural College	No Ayrshires		
21	University of Idaho	No Ayrshires		
22	University of Kentucky	No Ayrshires		
23	University of Tennessee	No Ayrshires		
24	North Dakota Agricultural College	No Ayrshires		

Ayrshires—Continued

RANK	OWNER	COW	MILK	FAT
		Junior two year old class		
			pounds	*pounds*
1	Kansas State Agricultural College	Melrose Canary Bell	13,785.0	502.9
2	Iowa State College	Ames Robin Hood Princess	10,600.0	467.2
3	Oregon Agricultural College	Oregon Panetta G	11,365.0	453.1
4	University of Maine	Majestic Girl of Orono	10,000.0	450.0
5	University of Maryland	Sunshine of Rossbourg	9,088.0	404.0
6	Connecticut Agricultural College	Mauchlin Snowdrop 2nd	8,050.0	357.8
7	University of California	California Barcheskie	7,859.0	352.3
8	University of Missouri	Campus Canary F	8,327.0	329.0
9	University of Nebraska	Bonalee B. Lincoln	6,878.0	323.0
10	Purdue University	Millie Woolford Fizzaway	7,265.0	265.0
11	University of Illinois	Violet of the Plains 2nd	6,731.0	260.9
12	University of Arkansas	No entry		
13	Massachusetts Agricultural College	No entry		
14	University of Minnesota	No entry		
15	New Jersey Agricultural College	No entry		
16	Pennsylvania State College	No entry		
17	Virginia Polytechnic Institute	No entry		
18	University of West Virginia	No entry		
19	Clemson Agricultural College	No Ayrshires		
20	Colorado Agricultural College	No Ayrshires		
21	University of Idaho	No Ayreshires		
22	University of Kentucky	No Ayrshires		
23	University of Tennessee	No Ayrshires		
24	North Dakota Agricultural College	No Ayrshires		

THE MINERAL REQUIREMENTS OF DAIRY COWS[1]

PRESENT STATUS OF THE QUESTION

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The discussion in this paper will be confined to the two elements, calcium and phosphorus. There is little reason to think that deficiencies of any other mineral elements play a very large or general practical rôle under ordinary conditions, except, perhaps, in the case of iodine. There is much evidence in existence which shows that in certain regions goitre develops in human beings as well as in farm animals as the result of an iodine deficiency in the food. But the discussion of this question is outside the scope of the present paper.

The subject of calcium and phosphorus deficiencies may be outlined under three questions.

I. Do deficiencies of calcium and phosphorus in the rations of dairy cows play an important practical part under present conditions of feeding?

II. Under what circumstances do such deficiencies occur?

III. How are they to be corrected?

I

The work of Forbes has probably done more to call attention to the possibility that dairy cows may often suffer from calcium and phosphorus deficiencies than that of any other recent investigator. Forbes has carried out approximately fifty experiments in which the calcium and phosphorus balances of dairy cows were determined (1). When the cows were giving liberal

[1] Paper read before the Production Section of the American Dairy Science Association, October 10, 1922, St. Paul, Minnesota.

quantities of milk, the calcium balances were always negative; and the phosphorus balances, usually so. In most of the experiments the rations were not such as one would naturally expect to be deficient in either calcium or phosphorus. On the contrary, they contained large quantities of alfalfa or other legume hay and of such concentrates as wheat bran and cottonseed meal, which have a high phosphorus content. The cows which were fed on such rations and which gave 30 pounds of milk or more daily had an average negative calcium balance of 10 grams daily. A cow which continued to lose calcium at this rate for a year would have suffered a loss of more than 3.5 kgm. of calcium at the end of that period—more than half of all the calcium which the average cow contains in her body. If Forbes' results are quantitatively representative of what occurs under ordinary conditions, it would seem that the practice of feeding cows so that they produce from 15,000 to 30,000 pounds of milk in the year, as is now so frequently done with cows on test, must very often result in disaster to the animals subjected to it.

There is reason to think, however, that Forbes' results, though very important and significant, are not quantitatively representative of what occurs under ordinary conditions. Some years ago the author in conjunction with others reviewed the metabolism experiments of the last fifty years in which calcium and phosphorus balances have been determined, and showed that the results of such experiments are such as to indicate that the conditions of balance experiments usually interfere with calcium assimilation (2). Very recently Hart and his collaborators have reported results which throw much more light on the subject (3). In Hart's experiments liberally milking cows were fed on rations of grain, corn silage, and alfalfa hay—practically the same rations that many of Forbes' cows got. The alfalfa hay used in these experiments was of two kinds. One lot had been cured in windrows with four days exposure to the sun; the other lot had been cured under caps. The cows which got the hay cured in windrows had much smaller negative calcium balances than Forbes cows—between 2 and 3 grams daily on the average. The cows which got the hay cured under caps had positive calcium balances.

It seems justifiable to sum up the evidence so far presented by saying that liberally milking cows, which are fed on large quantities of good alfalfa hay combined with concentrates high in phosphorus, and kept under favorable general conditions, are usually able to maintain themselves in calcium and phosphorus equilibrium. But it is highly probable that minor circumstances, which have hardly been noticed heretofore, such as changes in the quality of the hay and changes in general routine, are capable of producing negative balances.

It seems, therefore, that it is not quite easy to keep liberally milking stall-fed cows in calcium and phosphorus equilibrium, even when the rations are of the best. What occurs when some comparatively low calcium roughage such as timothy hay, oat straw, corn stover, or corn silage is substituted for the alfalfa? On this question there is no shadow of disagreement in the evidence from various sources.

Both Hart and Forbes have determined the calcium balances in liberally milking cows which received timothy hay or other roughage low in calcium. In all cases the calcium balances were markedly negative, the figures indicating that the cows were losing about 20 grams of calcium daily. In view of the possibility that the conditions of balance experiments may interfere with calcium assimilation, experiments are now being carried out at this station in which cows under ordinary farm conditions are being fed a high protein grain mixture combined either with timothy hay alone or with timothy hay and corn silage. The milk yield of these cows is being compared with others fed either on the same rations with calcium carbonate added; or on rations with the same protein content and otherwise as nearly as possible similar, but with alfalfa hay substituted for the timothy. These experiments are still far from complete, but the results so far agree in showing that the milk yield is always sooner or later markedly reduced by the rations with the low calcium roughage, and that a considerable part of this reduction at least, is caused by the calcium deficiency.

There is every reason to believe, therefore, that liberally milking stall-fed cows can be kept in calcium equilibrium only by

feeding large quantities of roughage high in calcium, such as alfalfa hay. It need hardly be said that this practice is by no means universally followed, and there is no doubt that calcium deficiencies play an important practical part in the feeding of dairy cows as practiced in many parts of the country.

II

The question of the circumstances under which dairy cows are likely to be fed rations deficient in calcium or phosphorus has already been partially answered. But there are a number of important points still to be taken up.

The question of the effect of pasture on calcium and phosphorus assimilation has so far not been touched. In 1911 Fingerling reported results which showed that phosphorus was better absorbed by farm animals from fresh green roughage than from the same material after it had been dried and converted into hay (4). More recently Hart has shown that the same thing holds true for calcium both in the case of the oat plant and in that of the alfalfa plant (5). Fingerling suggested that the phosphorus compounds might be encrusted in the dried hay so that the digestive juices of the animals to which they were fed could not get at them. But, since his results were published, much work has appeared which indicates that the assimilation of calcium and phosphorus is influenced by vitamines. The vitamines in question may exert their influence even though they are fed as a part of one of the dietary constituents; and the calcium and phosphorus compounds, as another. Hart inclines to the view that fresh green plant tissue contains a vitamine which is favorable to calcium assimilation.

The evidence reviewed in section I, therefore, must be taken as applying only to animals which are fed exclusively on dried materials and corn silage. Dairy cows on pasture can maintain calcium equilibrium on a smaller absolute calcium intake than those on dried materials with or without corn silage. But the details of this subject remain almost wholly to be worked out. It will be necessary in the future to gather further evidence on the question whether the hypothetical vitamine in green plant

tissue can be separated from the calcium and phosphorus compounds thereof and still retain its potency, whether it is contained in equal amounts in various species of plants, whether it is so potent that we may safely neglect the actual calcium and phosphorus content of the rations in the case of cows on pasture, how it may best be conserved in the curing of hay, etc., etc. These and similar questions seem to the author to call as urgently for solution as any others in the field at present; not only for the sake of the dairy industry, but also for that of the science of nutrition in general.

There are two other subjects which come properly in this section, on which our present information is very scanty, but which cannot be passed over without mention; namely the relation of calcium deficiency in the ration to the quantity of the milk yield, and the question whether, under practical circumstances, it is common for rations to be fed in which the chief deficiency is that of phosphorus.

Forbes has reported the results of determining calcium and phosphorus balances in the case of cows that were dry or giving only small amounts of milk. Both calcium and phosphorus balances were usually positive. The cows used in these experiments, however, received alfalfa hay. The results of feeding timothy hay to cows giving small amounts of milk have been observed to some extent at this station. The observations are not sufficient to justify any very positive statements. When cows giving small amounts of milk are changed from alfalfa to timothy hay, the yield does not fall off so soon or so markedly as when this change is made at a higher level; and some of the cows on timothy hay have continued to give a small amount of milk (in the neighborhood of five pounds daily) for many months consecutively. These cows, however, were consuming rations which contained much more protein and total nutrients than they required according to any of the feeding standards. It is doubtful whether the results should be considered anything more than examples of the fact that cows giving small amounts of milk can eat much more food than they require, and, in that way, compensate for the partial deficiency of some particular element of

the food. It is perhaps not too strong a statement that it is always bad practice not to include liberal quantities of legume hay in the rations of dairy cows which are receiving only dry feeds and silage.

The cases where a deficiency of phosphorus in the rations of dairy cows plays an important practical part are probably much less common than in the case of calcium. The only rich source of calcium for these animals is legume hay, and it is easy to make up a ration without legume hay, but which nevertheless contains plenty of protein and total nutrients to provide for the most liberal milk yield. But phosphorus is plentifully contained in most of the high protein concentrates as well as in wheat bran, and most rations which contain enough protein and total nutrients to provide for a liberal milk yield, contain large quantities of phosphorus also. In her dry period, however, a cow can easily eat enough roughage to cover her requirements, and, under these circumstances, she may be getting a ration which is rather low in phosphorus. This station recently published a bulletin in which it was shown that the milk yield of cows which had been subjected for some years to the station routine could usually be improved by adding sodium phosphate to the ration given in the dry period.

The favorable effects of feeding phosphate in the experiments under consideration, however, were due to the cows having received deficient rations in their previous lactation periods. The results cannot, therefore, be regarded as proof that animals which should begin their dry periods in an ideal state of nutrition would suffer from a shortage of phosphorus during that period, even though they were fed chiefly on roughage with a low phosphorus content.

III

The question how calcium and phosphorus deficiencies in the rations of dairy cows are to be avoided has been answered nearly as far as it can be answered in the two preceding sections. The evidence now on hand indicates that the calcium question is much the more urgent of the two; that liberally milking cows

probably always suffer from a calcium deficiency when they are fed on dry rations with or without silage and without a liberal admixture of alfalfa or other legume hay; but that they can be kept in calcium equilibrium if enough alfalfa hay of the right quality is provided. The evidence also indicates that the danger of a calcium deficiency is less acute when the cows are on pasture. In regard to the question of improving dairy rations which are low in their natural calcium content by the addition of a salt of this element, the evidence indicates that the improvement so obtained is very limited. The practice is not to be recommended for the present, except to help the dairy farmer out of a temporary dilemma.

What ought to be done by the practical dairy farmer in the light of present knowledge is perfectly clear. In feeding his cows he should follow the example of the engineer who has to build a bridge out of materials that may be faulty, and build somewhat stronger than the calculations call for. He should not attempt or hope for large yields of milk through the winter unless he has alfalfa or other legume hay at command. If he has alfalfa, it will probably pay him to feed a pound of it for every three or four pounds of milk that he obtains. And it will probably pay him also to see that each of his cows has a dry period of two months and that during that period she receives twice the maintenance ration in protein and total nutrients.

But most of all it will be worth while for him to realize how small and dim is the present light of knowledge in the vast field of ignorance of nutritional questions. In attempting to give practical advice, it is impossible at present to step out boldly in any direction. It is commonly thought that other legume hays can be substituted for alfalfa as a source of calcium, but there are no satisfactory experiments on the subject. The commonly received opinion is largely guess work. And the enormously important question of the calcium requirement for cows on different kinds of pasture has hardly been touched. The practical dairyman should realize that these questions and other similar ones can be answered by further work on the subject, and he should encourage attempts to answer them as far as he can.

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STUDIES IN THE GROWTH AND NUTRITION OF DAIRY CALVES

V. MILK AS THE SOLE RATION FOR CALVES

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From time immemorial milk has been regarded as the feed best adapted to the complete nourishing of mammalia. It is the sole ration of all mammals during the earlier part of their post-natal development and is also recognized as an excellent staple in the diet of the adult human, especially in the case of invalids. On the farm it is used extensively in the feeding of young animals, and in the case of the hog it is fed in large quantities to more mature individuals.

Within the last decade much investigational work has been done concerning the nutritive value of milk and other feed stuffs. The major portion of this work has been conducted with laboratory animals and no attention has been paid to some of the factors which determine to a large extent the value of milk to certain types of livestock. The object of the work reported here was to determine the value of milk as the sole ration for calves.

RÉSUMÉ OF PREVIOUS WORK

The nutrients recognized as essential to the welfare of the animal organisms are carbohydrates, fats, proteins, ash, water and the food accessories or vitamines. The proximate composition of milk, showing the average amounts of the most abundant constituents present, is given in the first tabulation.

The proteins, fats and carbohydrates are present in the proportions that are recognized as being suited for the growth of young animals and the ash constituents are also abundant.

Within recent years it has been shown that all proteins are not of equal value for nutritional purposes as the nutritive value of a protein is determined by its amino-acid constitution. Some proteins are inadequate due to the fact that they do not contain all the amino-acids necessary for the life, growth and normal physiological development of animals. However, it has been shown by McCollum (26) that the milk proteins are adequate, that is, they will in the presence of a sufficiency of non-protein and inorganic nutrients, support life, promote growth, and foster all normal physiological functions.

The ash is another feed constituent which, though present in sufficient quantities, may not be qualitatively suited to the requirements of the animal, but it has been proved by Osborne and

TABLE 29

Average composition of milk (31)

CONSTITUENT	PER CENT
Water	87.17
Fat	3.69
Casein	3.02
Albumen	0.53
Sugar	4.88
Ash	0.71

Mendel (28) that the ash of milk satisfactorily meets the demands of the young growing animal, providing in the proper proportions all of the inorganic constituents needed for the proper functioning of the animal body.

Another factor recognized as limiting the nutritive value of feeds is the presence or absence of the vitamines, fat-soluble A, water-soluble B and water-soluble C. The fact that fat-soluble A is present in abundance in milk has been proved many times as can be seen from the compilations of Blunt and Wang (16), (17). Milk is not too rich in water-soluble B, according to Osborne, Mendel, Ferry and Wakeman (29) but there should have been sufficient of it supplied, according to McCollum, Simmonds and Pitz (27), to satisfy the experimental animals. It is perhaps true, however, that insufficient amounts of water-soluble C were present according to Chick, Hume, Skelton and Smith (18), (19).

Thus far only work conducted with laboratory animals has been mentioned as this leads up to and helps to explain some of the results obtained on using rations from limited sources with farm livestock. In addition to its chemical character a ration must be of the proper physical nature before it supplies the needs of farm livestock.

In only a few instances have records been obtained of ruminants being fed for any considerable time on rations consisting entirely of feeds of the same physical character, but Sanborn (30) reports that in the case of both sheep and cattle fed on grain the stomachs weighed less than normal and this was most noticeable in the case of the rumen—the stomach compartment especially adapted for the handling of bulky material. Davenport (20) found that calves could not be raised on a ration consisting of milk alone or grain alone and he also noticed that as a rule no digestive disturbances accompanied such a ration.

Work of McCollum, reported by Henry (21), apparently showed that a sow pig was able to reach maturity and reproduce normally when fed milk alone.

EXPERIMENTAL WORK

In the work reported here, two bull calves were used and they were fed on milk alone from birth until the time of their death. The animals are described in table 30.

Both calves were allowed to remain with their dams for a few days after birth and were then put on a whole milk ration. The amount of milk fed was limited to what the calves seemed able to handle satisfactorily and though they might possibly have become accustomed to larger quantities, it was deemed advisable to keep their consumption of milk comparable to that of other animals of similar weight in the herd and thus prevent digestive troubles as far as possible.

No roughage, grain or water was offered to either of the calves, and at first no salt was given, but from the time calf 355 was 70 days old, a salt roll was kept in front of him at all times and the same treatment was given calf 366 from the time he was 30 days old.

The calves were kept in a pen bedded at first with shavings and later with sand, as they showed a tendency to eat the shavings. Their feed consumption by 10-day periods is given in table 31.

TABLE 30

Animals used

	CALF NUMBER	
	355	366
Breeding	Grade Jersey	Grade Holstein
Date of birth	9–25–16	12–17–16
Birth weight, pounds	65	90

TABLE 31

Feed consumption by ten-day periods

PERIOD NUMBER	CALF 355		CALF 366	
	Milk	Salt	Milk	Salt
	pounds	*pounds*	*pounds*	*pounds*
1	36		90	
2	90		90	
3	90		90	
4	90		90	0.04
5	128		111	0.05
6	120		129	0.06
7	120		150	0.04
8	126	0.32	150	0.03
9	146	0.25	150	0.11
10	150	0.17	150	0.21
11	150	0.05	150	0.10
12	150	0.02	150	0.03
13	150	0.04	150	0.04
14	150	0.06	150	0.03
15	141	0.05	150	0.03
16	120	0.03	150	0.02
17	120	0.07	174	0.03
18	120	0.18	108	0.03
19	123	0.17		
20	142	0.02		
21	99	0.03		

In the first 10-day period calf 355 sucked for 6 days and no. 366 for 3 days. The last period for no. 355 contains only 8 days and that for no. 366 only 6 days, as no. 355 died when 208 days old, and no. 366, at the age of 176 days.

It will be noted that up until he was about 100 days old, no. 355 had an increasing capacity for milk, but from that time the appetite remained regular for a little over a month and then declined, though there was an increase in milk consumption for a week or so before death. In the case of no. 366, maximum capacity was reached earlier and remained constant until about the same length of time before death, when it again increased.

The animal, no. 355, that received no salt until 70 days old, showed an enormous appetite for salt during the first 30 days in which it was available. From this time on his salt consumption decreased and with the exception of a short time between the ages of 170 and 190 days it did not again reach a marked elevation during the experiment. Calf 366 received salt earlier in his life and did not at any time have such an excessive consumption, though between the ages of 80 to 110 days his consumption of salt was large.

There were no marked digestive disturbances, except in the case of calf 366, which was bloated for a few days before death, the bowels of the animals being usually laxative, though not noticeably so. The feces were rather foul smelling. The calves showed by their actions that their rations were not entirely complete. They ate to a slight extent the shavings that were at first used as bedding, gnawed the wood in the walls of the pen, and licked the hair from each other. These substances, however, were not consumed in amounts sufficient to cause very noticeable digestive derangements.

Records of the live weights and body measurements of the calves obtained every 30 days are given in table 32. The live weights given are the averages for three successive daily weighings. The body measurements taken were height at withers, depth of chest and width at hooks. For the sake of comparison, the measurements of the heifer calves in the herd fed normal rations are given. Difference in sex will not have much influence on these figures for comparative purposes owing to the sexual immaturity of the animals and also to the fact that calf 355 was castrated when 22 days old.

It can be seen that the experimental animals grew fairly well until they were two to three months of age, but from this time on

they did not thrive. They continued to gain slowly in weight for another 30 days, after which their live weights decreased gradually until the time of death. The body measurements appeared to increase about normally until the time the live weight increase ceased to be rapid and from this time on the measurements changed only slightly—in fact they were almost constant. A greater increase in height than is shown by the figures probably did occur, but owing to the fact that the animals began to go down on their pasterns about the time the live weight ceased to increase, the true height could not be accurately measured.

TABLE 32

Live weights and body measurements

AGE	CALF 355				CALF 366				AVERAGE FOR 40 HEIFERS			
	Weight	Height	Depth	Width	Weight	Height	Depth	Width	Weight	Height	Depth	Width
days	*pounds*	*inches*	*inches*	*inches*	*pounds*	*inches*	*inches*	*inches*	*pounds*	*inches*	*inches*	*inches*
Birth	65				90				67			
30	76	29.9	12.6	7.1	103	28.0	14.3	7.5	90	28.7	11.4	6.7
60	107	31.1	13.0	7.5	139	30.3	14.3	7.9	120	30.7	12.8	7.5
90	132	32.3	13.8	7.9	165	32.7	14.7	8.7	163	32.9	14.2	8.5
120	145	33.9	15.0	8.3	174	35.0	15.7	8.7	211	34.8	15.4	9.4
150	144	35.0	15.4	8.3	172	35.4	15.7	9.1	262	36.4	16.7	10.2
180	137	34.6	15.0	8.3					314	38.4	17.9	11.2

The increases in live wieght and body measurements can be more easily appreciated when they are shown as percentages of the original figures, as in table 33. The increases in live weight from birth to the end of the last completed 30-day period in the case of experimental animals, and to the ages of five and six months in the case of the herd average, are expressed as percentages of the birth weights, while the body measurements are compared in the same way from the time the animals were 30 days of age.

During their lifetimes the experimental animals practically doubled their live weights, while during similar lengths of time calves normally fed attained weights more than four times as

great as their birth weights. Similarly the increases in body measurements in the case of the calves fed milk alone were much less than normal, except in the case of the height of calf 366, which was normal. Of the increases in body measurement, the height was the most nearly normal, while width was farthest from it, and as a general rule the rates of growth in the body measurements showed less variation from normal than did the rate of gain in live weight.

In addition to the variations in weight and body measurements there were other abnormal symptoms which though very appreciable were not capable of being directly measured or deter-

TABLE 33

Percentage increase in live weight and body measurements

CALF	AGE	WEIGHT	HEIGHT	DEPTH	WIDTH
	months	*per cent*	*per cent*	*per cent*	*per cent*
Experimental:					
No. 355	6	111	14	19	17
No. 366	5	91	27	11	21
Herd average	6	369	34	57	67
	5	291	27	47	52
Percentage of normal rate of increase:					
No. 355	6	30	41	33	25
No. 366	5	31	100	23	40

mined. The animals became very much emaciated and quite unthrifty in appearance. Their coats were long and staring and the hair fell out freely. Patches of the body became practically devoid of hair and sores were also apparent. As has already been mentioned, the animals were down on their pasterns and could not stand up properly and they walked with a very stiff gait.

One very noticeable feature of the experiment was the occurrence of fits. These fits were first apparent when the animals were between three and four months of age and continued to occur at frequent but irregular intervals up until about three

weeks before the animals died. These fits were all very similar and frequently started for no apparent reason and could almost always be induced by leading the animals around for a few minutes. The animal would fall down and bellow as if in pain; the jaws would stick open and the legs become rigid; the muscles became tense and hard; respiration slowed and in severe attacks entirely stopped. Where respiration did not stop the animals would recover in a few minutes, and where breathing ceased, artificial respiration had to be resorted to, to resuscitate the calf. The fits were practically identical with those of an epileptic nature.

Post-mortem examinations of both calves were made. The bones of no. 355 were very flexible as if insufficient ash were present; the leg bones could be bent comparatively easily, while the ribs had a very thin coating of hard material with a soft core. None of the bones were as rigid as would be expected in an animal of similar age. There was one atrophied kidney (perhaps congenital) with hypertrophy of the other. The mesenteric lymph glands were much enlarged and there was an apparent leucemia. The rumen was of normal size, but the walls were evidently atonic, due apparently to a development of lymphoid tissue. The omasum was smaller than would be expected, though the two remaining compartments of the stomach appeared to be normal. The contents of the rumen resembled thin cottage cheese mixed with hair.

The bones of calf 366 appeared to be in fairly good condition, though one or two of the ribs might previously have been broken and healed. The mesenteric lymph glands were enlarged and both kidneys were in bad condition with cysts. All the stomach compartments were of about normal size, but there were streaks of dark brown or black pigment on the inner wall of the abomasum. The contents of the rumen were similar to those in the case of calf 355.

DISCUSSION OF RESULTS

Whole milk, though apparently giving good results until the animals are about three months old, very probably cannot be

relied on as the sole ration for calves of greater age. Its inability to properly nourish older calves may be due to one or more of a number of factors.

Cattle and other ruminants begin to consume roughages at an early age and the lack of roughage may consequently give an explanation of the results obtained in this work. In addition the quantity and quality of the nutrients supplied may be of importance as well as the supply of nutrients.

In table 34 are given the requirements of young growing dairy calves according to the modified Wolff-Lehmann feeding standard as outlined by Henry and Morrison (22).

From the data supplied the nutrients required by, and actually supplied to the experimental calves have been calculated. In this table the animals have been taken together rather than

TABLE 34

Nutrients required daily by young growing calves per 1000 pounds live weight

WEIGHT	DRY MATTER	DIGESTIBLE NUTRIENTS	
		Crude protein	Total
pounds	*pounds*	*pounds*	*pounds*
150	23	4.0	22.0
300	24	3.0	18.3
500	27	2.0	15.8

individually and the milk consumption is taken for all 30-day periods which were completed. It was assumed that the daily milk consumption of the calves while sucking was the same as in the succeeding days of the first 10-day period.

The actual surplus or deficit of nutrients supplied will be more valuable for comparative purposes and this is obtained by summarizing the data just presented.

Considerable variations are noticeable in the amounts of the nutrients supplied but the importance of these variations is perhaps best demonstrated when the oversupply or deficiency is expressed as a percentage of the actual amount required by the calves.

It is evident that from the beginning the calves were not receiving sufficient dry matter in their rations. The average

amount of dry matter supplied in the first 30 days was 33 per cent below that required by the animals and this deficiency continued to become greater until in the fifth 30-day period it amounted to 66 per cent.

During the first two 30-day periods the calves received sufficient digestible crude protein and total digestible nutrients but from then on these constituents were deficient in the rations but never to such a great extent as was the dry matter. The calves were being given all the milk they could handle but were supplied with no bulky feed to supply them with the extra dry matter needed. The lack of this dry matter, which would have provided additional bulk, impaired the digestive powers of the animals and rendered them unable to handle sufficient milk to provide all the digestible nutrients they required. This in turn led to poor growth and development.

The digestive tract of a ruminant is large and capacious and before digestion can be normal, bulky feeds must be present to distend the digestive organs, stimulate peristalsis, separate the particles of more concentrated feeds and so allow of their being properly mixed with and acted on by the digestive fluids. Milk, being highly digestible and free from fibrous material, is not a "bulky" feed, though its nutrients are present in a rather large volume of water, and so it cannot, when fed alone, induce the digestive system of older ruminants to function properly, though it is quite efficient with young calves, as in their case the rumen is relatively smaller in comparison with the rest of the digestive tract than it becomes ultimately.

Where digestion is retarded or hindered, as would occur when the digestive system became atonic due to the absence of roughage, the materials not completely acted on by the digestive juices would remain in the alimentary canal and undergo putrefactive changes. The products of such putrefaction are toxic and when absorbed from the alimentary canal can produce autointoxication, with symptoms similar to those found with the experimental animals in this case.

Another fact worthy of note is that these calves were at times, when averaging about 150 pounds in live weight, consuming over

half as much salt per day as would a 1000-pound animal. It has been found at this station that normally fed calves of similar weight will consume about 0.01 pounds of salt per day, while the experimental animals consumed as much as 0.03 pounds per day.

This excessive salt consumption may have been an attempt to correct digestive disturbances, or it may have been caused by other physiological demands, or it may simply have been due to to the calves forming a pernicious habit.

That sodium chloride can produce tetanic convulsions such as were evident in the case of the experimental calves has been shown on several occasions. Loeb (23) demonstrated the contractions and final tetanus of muscles in contact with certain salt solutions

TABLE 35

Nutrients required by and supplied to calves

AGE	AVERAGE LIVE WEIGHT	MILK SUPPLIED	NUTRIENTS SUPPLIED			NUTRIENTS REQUIRED		
			Dry matter	Digestible		Dry matter	Digestible	
				Crude protein	Total		Crude protein	Total
days	*pounds*	*pounds*	*pounds*	*pounds*	*pounds*	*pounds*	*pounds*	*pounds*
1–30	168	579	79	19	104	116	19	109
31–60	213	668	91	22	120	150	23	133
61–90	272	842	115	28	151	195	26	149
91–120	309	900	122	30	161	223	27	169
121–150	318	873	119	29	166	228	28	173

and he later (24) showed that solutions of common salt could cause rhythmical twitchings and an increase in the irritability of muscles and nerves. This is due to an increase in the concentration of sodium ions and can be counteracted by the addition of calcium salts. It has also been pointed out by MacCallum (25) that intravenous injections of solutions of sodium chloride increase peristalsis. There is a possibility, therefore, that the fits to which the experimental calves were subject may have been due in some way to excessive salt consumption.

It has been pointed out previously that the vitamines, water-soluble B and water-soluble C may not be present in milk in sufficient amounts for the continued well being of the experimental

animals. Further work is needed to determine whether each or all of these factors mentioned here were responsible for the unthriftiness, mal-nutrution and ultimate death of the animals used in this work.

TABLE 36

Excess of nutrients supplied to calves

AGE	DRY MATTER	DIGESTIBLE NUTRIENTS	
		Crude protein	Total
days	*pounds*	*pounds*	*pounds*
1–30	−37	0	5
31–60	−59	1	13
61–90	−80	−2	−2
91–120	−101	−3	−8
121–150	−147	−1	−7

TABLE 37

Excess of nutrients supplied to calves expressed as a percentage of the requirements

AGE	DRY MATTER	DIGESTIBLE NUTRIENTS	
		Crude protein	Total
days	*per cent*	*per cent*	*per cent*
1–30	−33	0	5
31–60	−39	4	10
61–90	−41	−8	−1
91–120	−45	−11	−5
121–150	−66	−1	−4

SUMMARY

From the evidence obtained in this work the following factors may be looked on as possible causes of milk being unable to supply all the nutritional wants of calves after they are a few weeks old.

1. The lack of bulk may arrest the development of the alimentary tract and prevent the proper digestion of the nutrients supplied by the milk.

2. Excessive consumption of salt, due to depraved appetite, or to an attempt on the part of the calves to correct nutritive disturbances, may have led to some of the disturbances noted.

3. The vitamines, water-soluble B and water-soluble C, may have been present in insufficient amounts and this may have induced the death of the calves.

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ANNUAL MEETING OF THE AMERICAN DAIRY SCIENCE ASSOCIATION

GENERAL SESSION

The seventeenth annual meeting of the American Dairy Science Association was held October 10, 1922, at the University Farm, St. Paul, Minn. President Eckles in his informal opening address urged greater support of the JOURNAL OF DAIRY SCIENCE, which is being carried by the publishing company at an annual loss, and the necessity of the Association securing an affiliation with the National Research Council. C. C. Thomas of Williams & Wilkins Company, publishers, emphasized the need of stronger support for the JOURNAL.

COMMITTEE REPORTS

The report of the Joint Committee of the International Milk Dealers' Association and Agricultural College representatives was given by A. A. Borland. (This report is published in detail on page 75.)

Report of Program Committee for World's Dairy Congress, L. A. Rogers, chairman.

Report of Editorial Board, J. H. Frandsen. (Report in detail on page 77.)

Dr. Eckles was made the fourth member of the committee on affiliation with the National Research Council, upon motion made by Dr. Breed, chairman of the committee.

The report of the Membership Committee was given by J. A. Gamble.

A. A. Borland read a paper on "Extension Activities and Their Relation to the College and Experiment Station." Professor O. E. Reed led the discussion that followed.

Officers for 1923, elected on the December ballot, are: President, A. A. Borland, State College, Pa.; vice-president, O. E. Reed, East Lansing, Michigan.

ANNUAL BANQUET

Nearly 300 were present at the annual banquet of the American Dairy Science Association, held at the Dairy Exposition ground at St. Paul. A. . Borland of Pennsylvania, vice-president of the Association, was toast-master. R. A. Pearson, president of Iowa State College, was the principal speaker.

STUDENTS' NATIONAL CONTEST IN JUDGING DAIRY CATTLE

The results of the Fourteenth Students' National Contest in Judging Dairy Cattle, held at the National Dairy Show on the Minnesota State Fair Grounds, October 9, 1922, were announced at the banquet by W. W. Swett, superintendent of the contest. North Dakota won first place for the best teamwork in judging all breeds; Oregon, second; Iowa, third. The North Dakota Agricultural College, therefore, was awarded the National Dairy Association and the Hoard's Dairyman cups, both of which were new and given to replace the two sweepstakes cups permanently awarded to Kansas State Agricultural College in 1921 on the basis of that institution winning them three successive years. Oregon Agricultural College, second, was given the Wyandotte cup offered by the J. B. Ford Company.

Teams from twenty colleges or universities, representing the following states, participated: Illinois, Indiana, Iowa, Kansas, Kentucky, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, New Hampshire, New Jersey, New York, North Dakota, Ohio, Oregon, Tennessee, Texas, West Virginia, and Wisconsin.

The National Dairy Association's medals, sweepstakes, for the best individual work in judging all breeds were awarded the following men: Oliver K. Beals, Oregon, gold; Harper J. Brush, North Dakota, silver; A. H. Jessup, Indiana, bronze.

The official judges on placing were W. S. Moscrip, Minnesota, for Holstein classes; J. A. McLean, Chicago, for Jersey classes; J. B. Robertson, Maryland, for Guernsey classes; and L. S. Gillette, Iowa, for Ayrshire classes.

The Students' National Contest in Judging Dairy Cattle has been held regularly for fourteen years and has been sponsored

not only by the American Dairy Science Association but by the National Dairy Association and the various breed organizations. It is believed that the work has been instrumental in unifying the instruction in dairy cattle judging in the colleges throughout the United States. The contest was under the supervision of the Dairy Division, Bureau of Animal Industry, United States Department of Agriculture.

(Signed) J. B. FITCH.

PROCEEDINGS OF SECTION I, DAIRY PRODUCTION

Meeting was called to order by Vice-Chairman A. C. Ragsdale in the absence of Chairman Regan.

Report of committee on methods of conducting students' judging contests was given by W. W. Swett, chairman. (This report is given in full on page 79.) The section went on record as discouraging any institution from taking an excessive amount of time from the college in preparation for contests. The section also recommended to the committee in charge that it arrange to have an associate college judge work with the breed judge next year.

The report of the committee on dairy cattle score card, given by J. R. Rice, was approved and the score card accepted and adopted as presented by the committee. (This report together with score card is given in full on page 80.)

The suggestion of Mr. Hayden that more scientific papers be presented and less routine matter discussed at annual meetings was discussed at some length.

Two papers were presented (printed elsewhere in this issue): "The Relation of Pigmentations to Fat Production in Dairy Cattle," by Dr. Palmer of Minnesota; "Mineral Requirement of Dairy Cattle," by Dr. Meigs of the United States Department of Agriculture, read by Mr. Davis.

Officers elected were: Chairman, O. E. Reed, Michigan; vice-chairman, W. W. Yapp, Illinois; secretary, A. P. Rayburn, Minnesota.

(Signed) H. O. HENDERSON,
Temporary Secretary.

PROCEEDINGS OF SECTION II, DAIRY MANUFACTURES

Session was called to order by Dr. L. A. Rogers, chairman, in Dairy Hall, University Farm, Minnesota. Forty-five were present at the call to order.

Report of the committee on score cards and standards

The report of the committee on score cards and legal standards was given by J. H. Frandsen, chairman. It included the following suggestions:

1. That the score card for whole milk be changed as follows: The points allowed for acidity to be eliminated and added to the points allowed for flavor.
2. That the score card for condensed and evaporated milk be changed by having the points allowed for body and texture and bacterial count increased, and the points allowed for fat and flavor decreased.

The section passed a motion that uniform rules should be used in all contests in which students take part this year.

On motion the duties of a committee on bacterial methods were added to those of the committee on official methods for testing milk and cream.

The new issue of methods of the American Bacteriological Society, including chemical methods for examining dairy products, and the report of the committee on standard methods were approved. The committee on standard methods, of which Professor Hunziker is chairman, will be continued and will take up the matter of differences of opinion between the American Dairy Science Association's standard methods and those published by the United States Bureau of Standards.

After considerable discussion Professor Stocking's motion that the committee on standard methods should include in its work the determination of a standard method for milk solids not fat determination was carried.

The utilization of by-products was the general topic of the symposium which formed the program. The following papers (published in this issue or to be published later in THE JOURNAL of DAIRY SCIENCE) were given:

"Utilization of Skim Milk by the Manufacture of Milk Powder," C. E. Grey, president of California Central Creameries.

"Utilization of Buttermilk for Hog and Poultry Feeding," O. F. Hunziker, manager of manufacturing department of Blue Valley Creamery Company.

"Utilization of Whey," A. C. Weimer, dairy manufacturing specialist, United States Department of Agriculture.

The following officers were chosen for 1923: Chairman, H. A. Ruehe, Illinois; secretary, J. R. Keithley, Minnesota.

(Signed) H. A. RUEHE,
Secretary.

PROCEEDINGS OF SECTION III, DAIRY EXTENSION

The Dairy Extension Section met in Dairy Hall, University Farm, St. Paul, Minnesota, 1:30 p.m., October 10, 1922.

Meeting was called to order by Chairman E. M. Harmon of the University of Missouri, Columbia, Missouri.

C. R. Gearhart, chairman of the committee on standardization of Cow Testing Association work, Manhattan, Kansas, gave a detailed outline of the work done by the committee in standardizing cow testing work. Mr. Gearhart stated that four state institutions have given credit toward graduation where a tester took up Cow Testing Association work. Two states have adopted the Register of Production plan of recording cows that have made more than 365 pounds of butterfat. The committee recommended a shorter constitution and by-laws furnished by the United States Dairy Division. When voted upon by the assemblage at this meeting, it was unanimously recommended that the new constitution and by-laws be adopted, and there were several changes made in the contract for membership agreement. It was finally agreed upon that two copies should be made of each contract which the members are signing. Twelve members voted for the check system to be adopted, while eight members voted against it. The committee's recommendations on rules and changes in the herd record book, and the details on recommendations for the new bulletin by Mr. J. C. McDowell, of the Dairy Division, were adopted.

A report was made by Mr. F. A. Buchanan, chairman of the Calf Club Association Committee. The states most active in calf club work are New Jersey, Nebraska, West Virginia and Missouri.

Mr. O. E. Reed of Lansing, Michigan, gave a splendid talk on the work that has been done along dairy improvement lines in the state of Michigan. He urged holding more of our group and community meetings directly on the farm and not in a town hall. Mr. Reed stated that invariably more of the real thoughts which the farmer should get were driven home more strongly on the farm than would be in a meeting held in a city.

Mr. L. W. Morley, chairman of dairy products committee, State College of Pennsylvania, gave a brief talk on the handling of butter, cheese and cream in the various states throughout the United States.

Mr. C. S. Rhodes of Urbana, Illinois, gave a report on Coordinating Extension Work with that of the resident departments, the state leaders and the county agents.

Miss Jessie Hoover, chairman of committee on milk campaigns, emphasized the marked increase in the consumption of milk and dairy products after a milk campaign had been successfully conducted. She stated that in Madison, Wisconsin, there was a 35 per cent increased consumption in milk alone in the course of one year.

A. C. Baltzer, chairman of bull association committee, gave an outline on the successful organizing and supervising of bull associations.

M. H. Keeney, New Brunswick, New Jersey, spoke on "How Can We Make of the Individual Cow Testing Association Member a Demonstration for His Whole Community."

A resolution was sent to Mr. George, thanking him for his services as secretary.

The following officers were elected for 1923: Chairman, E. M. Harmon, Columbia, Mo.; vice-chairman, M. N. Lauritson, Lincoln, Nebr.; secretary-treasurer, A. J. Cramer, Madison, Wis.

PROCEEDINGS OF SECTION IV, OFFICIAL TESTING

The following is a summary of the proceedings of the official Cow Testing Section of the American Dairy Science Association, which met October 11, 1922, at St. Paul. The session was called to order by Chairman H. P. Davis. Roy T. Harris was secretary.

The data concerning the importance of the preliminary milking was reviewed and summarized by Professor Borland of Pennsylvania. The work at Nebraska, Kansas, New Jersey and Pennsylvania contributed to the following conclusions of the conference, viz.: Leaving milk in the udder may result in (a) a higher milk yield during the two-day period; (b) a higher fat yield during the two-day period; (c) a higher test during the two-day period; and (d) would help to conceal padding of milk sheets. These conclusions were concurred in by officers of the American Jersey Cattle Club and the Holstein-Friesian Association and by Jersey breeders present. It was also pointed out that the preliminary milking fixes the hour of the first milking so that padding of milk records cannot be concealed by extending the milking period. It was voted unanimously that the preliminary milking should be retained if a satisfactory substitute could not be found.

Professor Colman's sub-committee report and the report of Mr. Baker of the American Jersey Cattle Club were then considered wherein the first, second, third and fourth milkings were compared with the corresponding milkings. It was agreed that the variation was so great that in the present light no standard could be set which would surely indicate deliberate attempt at fraud.

The preliminary milking should therefore be enforced with all breeds until amended by the American Dairy Science Association. The uniform blanks which are being prepared and which should be in use by February 1 provide a space in which to enter the weight and test of the preliminary milking. This will not be included in the totals and averages, but will serve for comparison with the other tests and as a check on the supervisor. All agreed that this was desirable and Mr. Gardner of the Holstein-Friesian

Association especially emphasized this point. The Jersey, Guernsey, Ayrshire, Holstein and Shorthorn Associations have adopted this uniform blank. No others have as yet ordered a supply.

The American Jersey Cattle Club representatives then asked for an opinion of a one-day test compared to the two-day test. This had been considered by the committee through a suggestion of Professor Erf of Ohio, who believes that a test period should be of short duration to prevent manipulation of the cow, and was objected to on the grounds that new steps should be taken only when sufficient information is available to justify changes in methods. The committee desires information on this subject and believes it to be a problem worthy of study by as many states as possible within the next year.

The Committee recommended the amending of Rule 9 by omitting "by pouring from one pail to another at least twice," which was adopted. In the same rule an amendment to read "in warm weather samples kept over night should be kept in a cool place or preservatives should be added to each sample" was also adopted.

The matter of collecting by Breed Association has thus far been blocked by three Associations which feel that they are not in a position to undertake it. Some breed officials do not approve of the plan in principle. The committee hopes through Mr. Munn of the American Jersey Cattle Club, who has been instructed by his directors, to get a uniform guarantee plan in operation in all of the Associations at once.

In all, the committee and sub-committee reports for the year and the proceedings of the St. Paul meeting, cover sixty-one type-written pages. Some of the general recommendations follow:

1. That each state accept the rules and plans as finally adopted at the conference and put the plan into operation January 1, 1923, or earlier. (Due to the delay, February 1 would now be a reasonable date.) There may be some real objections to the present rules and some will have to give up a few "pet ideas," but we believe the rules adopted by the Official Testing Section should prevail in all states.

2. That any modification or addition to these rules should be duly presented to this committee which in turn will present them to the general body at the annual meeting and that these rules should always be regarded as a minimum standard in conducting tests. It is only by this plan that we can keep the work on a high plane, command the unwavering support of the Breed Associations in this work, and develop uniformity of procedure among the Associations themselves.

3. That the rules as adopted by the American Dairy Science Association should be placed in the hands of the supervisors and breeders in each state by the superintendent of Advanced Registry of each state.

4. That the state superintendents and their assistants should show due consideration for the breed association officers and endeavor neither to write nor speak to breeders in such manner as to bring embarrassment to the officers, except where the matter has been given due consideration.

5. That superintendents conducting retests have the authority to go beyond the rules if deemed necessary to safeguard the records.

Mr. Baker of the American Jersey Cattle Club suggested the desirability of a uniform plan where state superintendents make monthly progress reports of high yielding cows. A number of these reports reach his office, each of which has its own pattern. The appended blanks are offered by the committee for presenting the principal data in making these reports.

The following were elected officers of the section for 1923: Chairman, Roy T. Harris, Wisconsin; secretary, G. C. White, Connecticut.

REPORTS OF COMMITTEES

Recommendations of a joint conference of the committee on agricultural colleges of the International Milk Dealers Association and representatives of the dairy departments of the agricultural colleges on the problems of training men for milk plant work

Held at the Curtis Hotel, Minneapolis, Minn., October 8, 1922.

It is the desire of the Agricultural Colleges to be of greatest service to the Market Milk Industry. It is believed that this

service lies along two general lines,—that of solving industrial problems and that of training men.

We also feel that more attention should be given by the Agricultural Colleges to the problems of the milk dealers. In accomplishing these ends the Agricultural Colleges desire the closest coöperation with the milk dealers so that the problems of both may be mutually understood.

The present suggestions are concerned with the development of men prepared to grow into the broader responsibilities of the business rather than the training of routine workers.

The aim of this training is to lay a foundation on a thorough knowledge of the fundamental sciences together with training in their application to the Market Milk Industry.

Such men should rapidly grasp the details of commercial problems and operations as they occur in the milk plants.

It seems to us that it is the duty of the milk plants to develop these technically trained young men into real milk plant experts.

The course of study which will best fit men for responsible positions in milk plants should include a thorough training in the fundamental sciences coupled with as much applied work as the student's time will permit.

The fundamental sciences should include Chemistry, Physics, and Bacteriology, each to be followed by courses making clear their application to the Market Milk Industry.

The applied courses should include work in Market Milk, Butter, Cheese (including fancy cheeses), Ice Cream, Condensed Milk, Powdered Milk, Dairy By-Products and Dairy Machinery.

The instructions in these courses should be directed toward showing the application of science to these subjects as well as developing manual skill.

Special attention should be given to the subject of economics. The work in this field should likewise include training in both the fundamentals and their application to dairy problems.

During the Senior year there should be a course in Milk Plant Management which should bring together and coördinate the previous teaching in the scientific and applied courses.

We feel that the milk companies can render valuable assistance

in the better development of good men by making it possible for students to get experience in milk plants during the summer months.

Report of Editorial Board. J. H. Frandsen, Editor

Field of the Journal of Dairy Science. A score of trade journals in the field now, covering practically every phase of dairy activities from milk production to the making of ice cream, furnish dairy information in popular language particularly adapted to the producer and manufacturer of the many and varied dairy products.

However, until the appearance of the JOURNAL OF DAIRY SCIENCE there was no medium open for the publication of technical and valuable scientific dairy papers except in condensed or in popular version.

It was to provide a vehicle for disseminating such scientific dairy data, as well as to provide a permanent record of such material easily available to students and investigators, that this JOURNAL was created. In this particular field the JOURNAL has no competitors and has been welcomed by teachers, investigators, law enforcement officials, producers, progressive manufacturers and editors of trade publications.

Since by common consent it has this splendid field all its own, the editorial board feels that it would be a serious mistake to attempt to cover any of the work now so well taken care of by the Trade Journals. Since the JOURNAL is the medium for the publication of essential scientific data, there is obviously every reason why it should not give space to long editorials—mere opinions of the editor or editorial board. As a matter of fact the editorial page of even our daily newspapers is fast losing its former place of influence, and one of our leading journalists even predicts that in the near future this page will be entirely eliminated from our modern newspaper.

For these reasons the editorial board feels that the JOURNAL OF DAIRY SCIENCE can render the best service to the Dairy Industry of America and is making no mistake by continuing its present policy of being preeminently a scientific publication. However, the

JOURNAL is yet in its childhood, and most of its development lies in the future. With a view to assist the prospective contributor the editorial board has deemed it desirable to issue the following statement of policy.

Statement of policy adopted by editors of Journal of Dairy Science, October, 1922. Since at the present time a larger number of manuscripts are submitted for publication in the JOURNAL OF DAIRY SCIENCE than the limited available space in the JOURNAL will accommodate, the editors have been obliged to adopt certain limitations in accepting papers for publication. Henceforth, it will be the policy of the editors:

1. To accept only in rare instances papers containing more than twenty (20) pages of material, double-spaced, standard letter-size, including tables, cuts and drawings.
2. To accept only such papers as have a direct bearing on dairy problems.
3. To exercise a more rigid culling of papers for publication from the standpoint of both subject matter and quality.
4. As a rule manuscripts that have appeared in other publications will not be used in the JOURNAL OF DAIRY SCIENCE.

Suggestions to authors. Contributors are urged to coöperate with the editors by observing the following rules:

1. Make papers as brief as possible without sacrificing completeness or accuracy.
2. Omit unnecessary plates and diagrams.
3. Do not present the same data by both tables and graphs. Use only the one that will present the results more effectively.
4. In case of duplicate determinations in tables, give only averages.
5. Avoid long historical reviews. Include only such references as have a direct bearing on the problem under study.
6. Submit only original type-written copy. Retain a duplicate copy.

Report of the committee on methods of conducting student judging contests. W. W. Swett, chairman

The committee on methods of conducting the Students' National Contest in Judging Dairy Cattle met at the headquarters of the National Dairy Show in Chicago at 10:00 a.m., April 14, 1922. Members present were: W. W. Swett, chairman, S. C. Thompson, H. H. Kildee, E. L. Anthony, and H. H. Wing. J. B. Fitch and W. M. Regan were unable to be present. Mr. Anderson from the office of the National Dairy Show, and J. C. McDowell of the Dairy Division were present to assist with some of the details of the work.

Mr. McDowell served as secretary on the request of Mr. Swett.

Suggestions from forty-five agricultural colleges regarding changes in contest rules were read.

Mr. Kildee made a motion, carried unanimously, to continue the one-judge system of last year.

On request of Mr. Thompson it was decided that the actual expense of the judges selected should, if possible, be paid out of Dairy Show funds.

It was moved by Mr. Kildee and seconded by Mr. Anthony that the per cent system of grading students on placings and reasons be used instead of the ranking system this year. The motion was unanimously adopted.

On motion of Professor Kildee, unanimously adopted, the number of student groups will be reduced from four to three. The purpose of the change is to facilitate student judging work in the ring.

Professor Wing made a motion that no reasons should be required on bulls and that students should write reasons on cows only. It was carried unanimously.

It was moved by Mr. Wing, seconded by Mr. Kildee, and unanimously passed by the committee that the same classes of animals should be used in this year's contest as in that of last year.

It was unanimously decided that the judge should decide the value of the various combinations used by the students in placing the animals of each class; that all the coaches should be present

when the animals of any breed are placed by the judge; that the judge should explain to the coaches his reasons for placing the animals and that he should dictate his reasons to a stenographer who will prepare a copy for each coach of the reasons committee of that breed, and also prepare a couple of copies to be placed on file among the permanent records of the contest.

It was unanimously decided that being an alternate on a team of a previous year should not debar a student from taking part in the contest.

Each member of the committee was given a definite bit of work along the line of securing additional prizes.

The committee decided that the per cent marks should not be limited to multiples of five, and that 15 minutes should be allowed to students to judge each class of animals regardless of whether reasons were to be written or not.

(Signed) J. C. McDowell,
Secretary.

Report of committee on dairy cattle score cards. W. M. Regan, chairman

The committee endeavored to formulate a dairy cow score card that would apply to the present day dairy cow, that would be acceptable to the majority of instructors, and understood by dairymen and students who do not have the help of a competent instructor. The old card made no attempt to indicate the relation between form and function.

The committee wrote to fifty-two institutions in the United States and Canada asking for copies of cards and suggestions for revision. Reports indicated that fifteen colleges use the old form of card, seventeen use a card that emphasizes the relation between form and function, and four use both. The committee believes adaptation of a standard score card is not vital for college instruction, but does believe that it is vital for the boys and girls who are studying dairy cows, and who have not had impressed upon them the relations between form and function.

Score card for dairy cows

SCALE OF POINTS	PERFECT SCORE	PER CENT CUT	STUDENTS SCORE	CORRECTED
I. Characteristics Indicating Dairy Form:				
(A) Style and general appearance—20 points				
1. Head erect, clean cut; neck slender, eye prominent, alert and placid	3			
2. Back straight and strong; hips wide apart and level	4			
3. Rump long, wide and level; thurl wide apart and high; level tail setting	5			
4. Legs straight, bone fine	3			
5. General build rugged and large for the breed without coarseness; Jerseys 950 lbs.; Guernseys and Ayrshires, 1100 lbs.; Holsteins, 1350 lbs.	5			
(B) Dairy Conformation—15 points				
6. The cow should be clean cut with feminine appearance; absence of tendency to lay on fat	5			
7. Shoulder, withers, vertebra, hips and pin bones prominent and free from fleshiness (period of lactation to be considered)	4			
8. Loin wide; ribs long and wide apart	3			
9. Disposition active, with good nerve control	3			
II. Characteristics Indicating Constitution, Vigor and Condition—15 points				
10. Chest broad and deep with well sprung ribs	8			
11. Nostrils—large and open	2			
12. Condition—thrifty and vigorous, in good flesh but not beefy	5			

SCALE OF POINTS	PERFECT SCORE	PER CENT CUT	STUDENTS SCORE	CORRECTED
III. Characteristics Indicating Ability to Consume and Digest Feeds—15 points				
13. Muzzle large; mouth broad	1			
14. Skin mellow, loose, medium thickness showing good circulation and secretion; hair soft	4			
15. Barrel deep, wide and long, well supported; ribs far apart	10			
IV. Characteristics Indicating Well Developed Milk Secreting Organs—35 points				
16. Udder:				
a. Capacity—large in size	7			
b. Quality—pliable, free from lumps	7			
c. Shape extending well forward and well up behind, level on floor, not pendulous, quarters full and symmetrical	6			
17. Milk veins—large, long, crooked and branching; milk wells large and numerous	7			
a. Milk veins on udder crooked, numerous and large	3			
18. Teats—convenient size, uniform and well placed	5			
	100			

Note: In case of any marked deficiency or any serious abnormality, as many as fifty points may be deducted from the total score of an animal. Beware of giving a thin beef cow as good a score as a dairy cow.

THE RELATION BETWEEN SKIN COLOR AND FAT PRODUCTION IN DAIRY COWS[1]

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It is well established that a high yellow color in the skin secretion of dairy cattle is indicative of their ability to produce milk and butter of a high yellow color. A belief exists among Guernsey and Jersey breeders that yellow color in the skin secretions is also related to high fat production.

Definite correlation between skin color and egg production in laying hens is known to exist (1). The correlation, however, is between high egg production and low skin color. It occurs only near or at the end of the laying season.

The origin of yellow color in the skin and egg yolks of fowls, like the origin of yellow color in the skin and butter fat of cows, is the carotinoid pigments in the diet. In fowls xanthophyll carotinoids are chiefly involved, while in cows it is carotin itself.

Palmer and Kempster (2) have shown that the xanthophyll in the hen's diet is deflected entirely to the ovaries during egg laying thus causing the skin to fade because of the removal of the supply of pigment for the skin which normally acts as one of the paths of excretion.

If any physiological relation exists between milk fat production in cows and egg yolk fat production in hens it is suggested that if any correlation exists between skin color and fat production in milking cows of certain breeds, it should be between low skin color and high fat production. As in the case of hens, however, such a correlation would occur only near or at the close of lactation before the cow goes dry and has an opportunity to restore the color lost from the skin. Hens which have stopped laying quickly

[1] Abstract of paper read before the Production Section of the American Dairy Science Association, St. Paul, Minnesota, October 10, 1922.

restore the natural yellow color to their skins on xanthophyll-containing foods.

Hooper (3), who has studied the possibility of a correlation between high color and high fat production, could discover no such relation. Certain of his data, however, indicate a correlation between low color and a higher fat production such as is suggested. The stage of lactation at which Hooper made his color observations is not stated in connection with his data.

It is proposed that those who are in a position to make observation on this question collect data to determine whether the character of the correlation suggested actually occurs. One result of such a study will be to place on a more scientific basis the ideas which are popularly held among certain breeders as to the relation between skin color and fat production.

REFERENCES

(1) BLAKESLEE, HARRIS, WARNER, AND KIRKPATRICK: Storrs (Conn.) Agri. Exp. Sta. Bull. 92, 95–194, 1917; Harris, Blakeslee, and Warner, Genetics, ii, 36–77, 1917.
(2) PALMER AND KEMPSTER: Jour. Biol. Chem., xxxix, 313–330, 1919.
(3) HOOPER: Kentucky Agri. Exp. Sta. Bull. 234, 159–161, 1921.

DAIRY NOTES

CALIFORNIA. Wm. Regan, for three years in charge of the dairy work at New Jersey College of Agriculture, is now in charge of dairy production work at the University of California located at Davis, Cal.

G. M. DRUMM, a graduate of the Kansas State Agricultural College and the Iowa State College, has been appointed dairy herdsman at the University of California at Davis.

IDAHO. G. C. Anderson, a graduate of the Kansas State Agricultural College, 1921, is assistant in dairying at the University of Idaho, Moscow, Idaho.

IOWA. A. C. McCandlish, for several years in charge of dairy production work at Iowa State College, has resigned his position and has returned to his home in Scotland where he hopes to establish a herd of Holstein-Friesian cattle. Earl Weaver has been promoted to the position made vacant by Mr. McCandlish.

KANSAS. B. M. Williams, a 1922 graduate of the University of Minnesota, has taken the position in dairy extension work at the Kansas State Agricultural College made vacant by W. T. Crandall. Mr. Crandall is extension dairyman at Cornell University.

NORTH DAKOTA. G. C. Biggar, a graduate of the North Dakota State College, has been appointed assistant in the dairy department at that institution.

PENNSYLVANIA. E. B. Fitts, for many years in charge of dairy extension work at Oregon Agricultural College, is now in charge of dairy extension in Pennsylvania with headquarters at State College, Pa.

TEXAS. George P. Grout, for many years manager of Jean Duluth farm at Nickerson, Minn., has assumed his new duties as Head of the Dairy Department at Texas A. and M. College.